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# MOTHZV-2: A COMPUTER SIMULATION OF *HELIOTHIS ZEA* AND *HELIOTHIS VIRESCENS* POPULATION DYNAMICS

## Users Manual

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# MOTHZV-2: A COMPUTER SIMULATION OF *HELIOTHIS ZEA* AND *HELIOTHIS VIRESCENS* POPULATION DYNAMICS

## Users Manual

By A. W. Hartstack, Jr., J. A. Witz, J. P. Hollingsworth, R. L. Ridgway, and J. D. Lopez[1]

## ABSTRACT

Consisting of a main program and 16 subroutines, MOTHZV–2 simulates the population dynamics of *Heliothis zea* (Boddie) and *Heliothis virescens* (F.) from egg to adult. The input includes measurable and reported factors influencing population development, such as crop phenology, temperature, moonlight, migration, predation, parasitism, oviposition, and cannibalism. The model accurately predicted field population of *Heliothis* eggs, larvae, and adults. The complete computer program and example input and output data are given. **KEY WORDS: computer-simulated *Heliothis* populations, *Heliothis virescens, Heliothis zea,* insect population dynamics, insect population forecasting, MOTHZV–2.**

## INTRODUCTION

MOTHZV–2 is a computer simulation of the population dynamics of *Heliothis zea* (Boddie) and *Heliothis virescens* (F.). It is based on MOTHZ–1 (*5*) and MOTHZ–2[2] but incorporates considerably more detailed population and physiological algorithms. Stinner et al. (*22*) described a somewhat similar *Heliothis* model; however, they did not include the details of various biological phenomena affecting population dynamics. Most of the basic factors, e.g., mortality, parasitism, and crop phenology, were entered in the context of the input data. Their model did, however, include a spatial grid of crop types so that movement of the population could be studied.

MOTHZV–2 consists of a main program and 16 subroutines. Simulation begins with input of either eggs or moths and can be carried through as many generations as occur during one season. No provisions are included for simulating moths entering or emerging from diapause. A bookkeeping system is used so that the numbers of eggs, first- to third-instar larvae, fourth- and fifth-instar larvae, pupae, preovipositing adults, and ovipositing adults can be recorded for each day of simulation. Printouts of all input as well as other calculated parameters are made along with daily population of simulated insects. Graphs of life tables are optional.

We describe the model in the order of the insects' life cycle events. The model can be used to simulate either *H. zea* or *H. virescens* or both

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[2] Hartstack, A. W., Jr. Model of *Heliothis zea*. 1973 Annual Report of the Cotton Insects Research Laboratory, College Station, Tex. 77840, 158 pp.

simultaneously. If in the following discussion no reference to species is made, both species are treated alike. Many biological factors other than those in the model affect *Heliothis* populations, but at this time these parameters are assumed to be constants or are neglected completely. Also, in some cases, more information is needed on the assumptions made in the model to enhance accurate prediction.

The program is written in FORTRAN and has been run on IBM 370 and AMDAHL 470 computers. It is stored on disk in compiled form at Texas A&M University Computer Center.

## DESCRIPTION OF MODEL

### Rate of Egg Production

Temperature has been shown to influence the number of eggs a moth lays, but research results have not been consistent (*2, 8, 17*). In general, maximum egg production is attained between 22.2° and 25.5° C and is reduced to nearly zero at 12.8° and 35° C. Figure 1 (G9) shows the relation between oviposition rate and temperature as described by

$$X = |75 - EGLYTM| \quad (1)$$

and

$$P_1 = 1.1 - 0.05146X, \quad (2)$$

where EGLYTM = average temperature (°F) during the 3-hour period after sunset (fig. 1:G7),

and $P_1$ = probability of oviposition (assumed to be 1.0 between 22.2° and 25.5° C).

Quaintance and Brues (*21*) and Phillips and Whitcomb (*18*) found that most eggs were laid in early evening. However, no data are available to predict what happens if temperature inhibits oviposition early in the evening but becomes ideal later or during the day. McColloch (*13*) stated that oviposition normally occurs at night but that it may occur during the daytime on cloudy or cool days. Accordingly, the 3 hours after sunset were assumed to be the oviposition period.

Moth age has been shown to affect fecundity (*2, 8, 17, 21*). Isely (*8*) and Quaintance and Brues (*21*) also found an interaction between age and temperature in which longevity and reproductive potential were greater at cooler temperatures (21.6°–26.7° C). Higher temperatures increased daily production of eggs but shortened the oviposition period, thereby reducing the overall reproductive potential. Figure 2 shows the oviposition period of *Heliothis* moths calculated for two temperatures. A function such as the gamma might fit these data; however, we used a linear approximation by fitting straight-line segments through the points determined by[3]

$$TRUN_i = \left( \sum_{j=i-AGE}^{i} TEMAVG_j \right) / AGE, \quad (3)$$

$$PREOVI = (5{,}330)\,(TEMAVG_i^{-1.82}) + 0.6, \quad (4)$$

$$IPEAK = (3{,}030{,}000)\,(TRUN_i^{-3.11}), \quad (5)$$

$$ITOP = (240{,}000)\,(TRUN_i^{-2.61}), \quad (6)$$

and

$$IEND = (911{,}000)\,(TRUN_i^{-2.53}), \quad (7)$$

where $TRUN_i$ = average temperature during moth's adult life on day $i$ = AGE,

$TEMAVG_i$ = average temperature for $i$th day of moth's life (°F),

AGE = age of moth on day of simulation,

PREOVI = length of preoviposition period (rounded to nearest whole day),

IPEAK = age (rounded to nearest whole day) when *Heliothis* moth attains maximum reproductive potential,

ITOP = number of days (rounded to the nearest whole day) a moth remains at maximum reproductive potential,

and IEND = age at which a moth no longer oviposits.

When the above events are calculated, a linear relationship between them is assumed, so egg production potential ($P_2$) can be readily calculated.

[3] Some of the terms used in the equations in the model description section of this paper may be slightly different in spelling or meaning from the terms used in the computer program. This was done to simplify explanation of what the simulation model accomplishes rather than how it is accomplished.

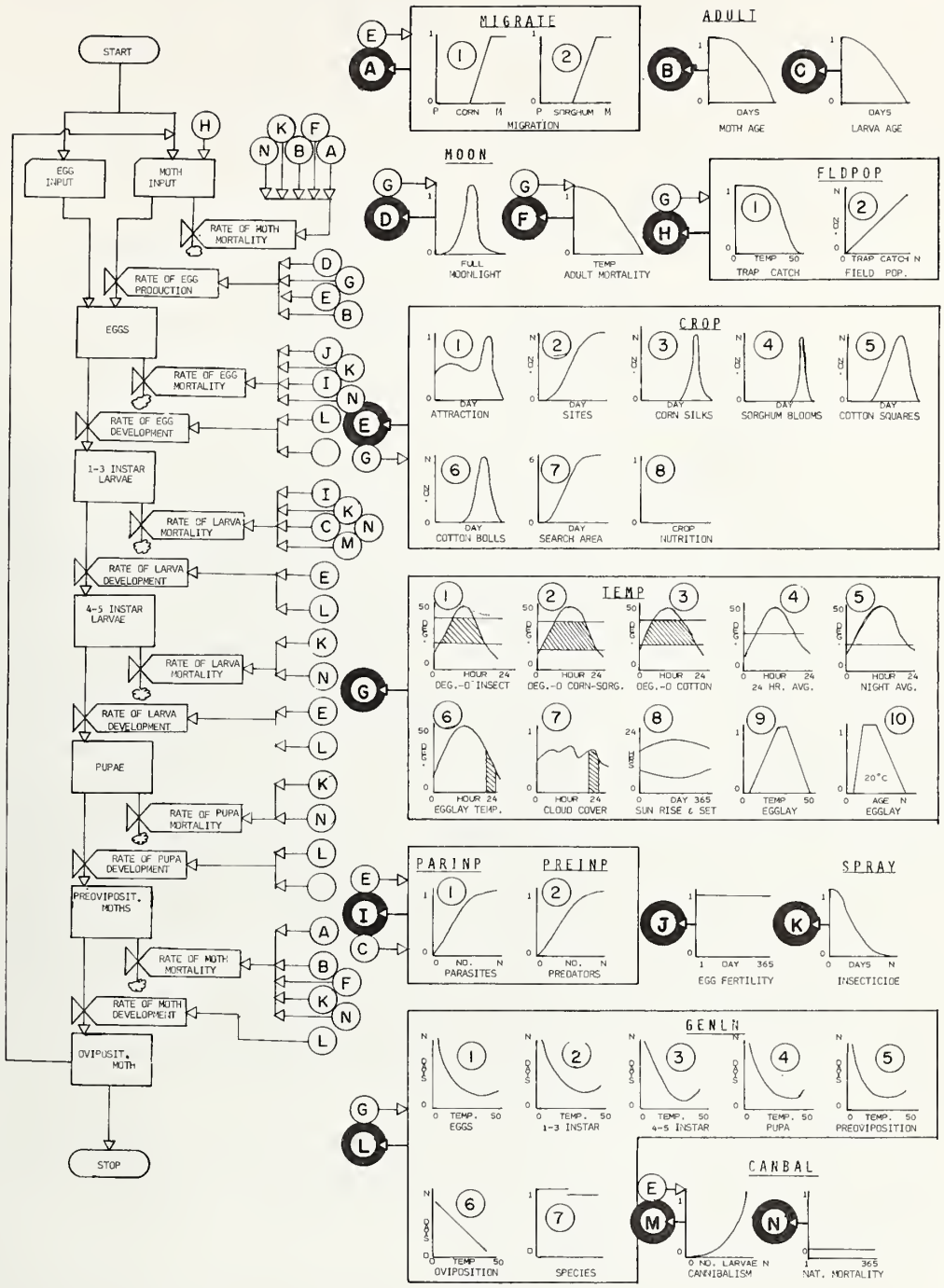



FIGURE 1.—Flow diagram of MOTHZV–2.

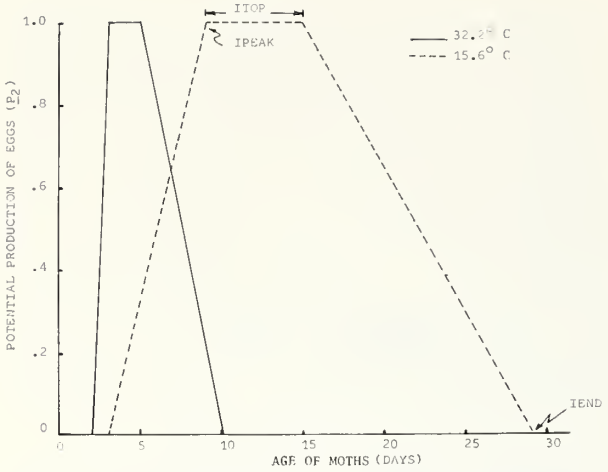



FIGURE 2.—The interaction of age and average daily temperature on reproduction potential of *Heliothis* moths.

Researchers have shown that phenological phenomena (e.g., silking date) have a significant influence on the probability of *Heliothis* moths' being attracted to a crop and ovipositing (*3, 6, 8, 13, 19*). This influence makes a crop submodel necessary. A corn model developed by Curry (*1*) was adapted to generate the needed corn phenology (fig. 1: E—1–3, 7, 8). (The probable attraction of corn, $P_3$, to *H. virescens* is assumed to be zero, since corn is not a reported host of this insect.) A simple sorghum model and a portion of SIMCOT II (*14*), a cotton model, were also adapted (fig. 1: E—1, 2, 4–8).

Nemec (*15, 16*) reported reduced oviposition by *Heliothis* moths during periods of full moon and during simulated moonlight. Oviposition was inhibited 3 or 4 days before full moon but was resumed 1 or 2 days after full moon and usually peaked 3 or 4 days after full moon. Hartstack's data (*6*) showed a significant reduction in rates of *Heliothis* population increase during moonlight periods. Consequently, if one assumes that maximum egg laying is from 2030 to 2330 hours (approximately, the 3-hour period after sunset), the relative amount of moonlight during that period can be calculated (fig. 3). Since the moon rises about 1 hour later each night, the 2030–2330 period has considerably more moonlight before full moon than after. The probability of maximum oviposition ($P_4$) in relation to moonlight is stored as a data array and used in the simulation as needed. The probability is increased (not >1.0) for cloud cover (e.g., if cloud cover is 50%, the effect of moonlight is reduced by 50%).

The egg-laying probability (EGLYPR) for a particular day is calculated by multiplying the four probability factors together:

$$EGLYPR = (P_1)(P_2)(P_3)(P_4). \quad (8)$$

The total number of eggs laid per moth per day (TOLEGG) is calculated by

$$TOLEGG = (EGLYPR)(EGPEMT), \quad (9)$$

where EGPEMT = maximum number of eggs a *Heliothis* moth could lay per day if all factors were ideal.

EGPEMT is assumed to be 300 and 400, respectively, for *H. zea* and *H. virescens* and would result in maximum lifetime laying of 2,000 to 3,000 eggs per moth (*8, 21*).

## Egg Mortality

There are many probable causes of egg infertility (e.g., temperature, population density, number of matings, and age). MOTHZV–2 uses a constant fertility rate of 90% (fig. 1: J). The model does not remove infertile eggs from the egg population until they should have hatched.

Parasites, specifically *Trichogramma* spp., are an important cause of egg mortality (*11, 13*). Detailed quantitative models for the population dynamics of various egg parasites have

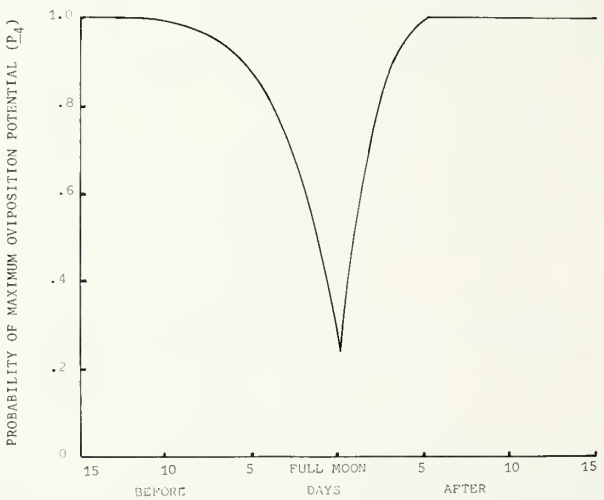



FIGURE 3.—The probability of maximum oviposition as related to the relative intensity and phase of moonlight during the 3-hour period after sunset.

not been constructed at this time; therefore, estimates must be used (fig. 1: I—2). Four options are available:

*Option 1.*—Enter number of parasites. Knipling and McGuire (*10*) presented an empirical population model of parasites based on the following assumptions: (a) 5,000 *Trichogramma* per acre would find 50% of the host eggs. (b) 10,000 *Trichogramma* per acre would search the same plant area twice. However, since searching is random, the additional 5,000 parasites would search one-half the area previously searched and one-half the unsearched area, thus leaving one-fourth the area unsearched. (c) The searching capability of *Trichogramma* and its efficiency in parasitizing host eggs are assumed to be completely independent of host egg density. These assumptions were based on a search area factor (SAREA) of 1.0, which is assumed to occur when the crop becomes attractive (6- to 12-inch height for corn) and to increase to about 6.0 at crop maturity. Equation 10 is Knipling and McGuire's model.

$$\text{PTRICH}=1-\exp\left(\frac{(-0.693)\ (\text{TRICH})}{(\text{N})\ (\text{SAREA})}\right), \quad (10)$$

where PTRICH=probability of parasitism by *Trichogramma*,
TRICH=number of parasites,
N=number of parasites required to obtain 50% parasitism,
and SAREA=relative search area.

N is assumed to be 5,000 (as postulated by Knipling and McGuire) for native egg parasites. N was calculated to be 45,000 for reared *Trichogramma* (specifically, for those reared at Agricultural Research Service's Cotton Insects Research Laboratory, College Station, Tex.). The number of parasites must be read in for each day of simulation. Figure 4 shows typical parasitism curves calculated by the model.

*Option 2.*—Enter daily percentage of parasitism. If the number of parasites is not available, an estimated daily percentage of parasitism can be read in.

*Option 3.*—Enter maximum daily rate of parasitism. The maximum daily rate of parasitism is assumed to occur in corn during the peak silking period (90%–95% silks present), when many eggs are present. From the egg parasitism percentage the model generates an egg parasitism curve starting from the day when the crop becomes attractive; figure 5 shows the curve for corn. Parasitized eggs are not removed from the egg population by the model until after the parasites would have emerged, since field counts of eggs may include parasitized eggs. A running total of parasitized eggs is kept so that the apparent field parasitism can be calculated for each day for comparison with field data for verification.

*Option 4.*—Enter number of *Trichogramma*. The rate of parasitism by *Trichogramma* is calculated as a function of the number and the age of adult *Trichogramma* and of environ-

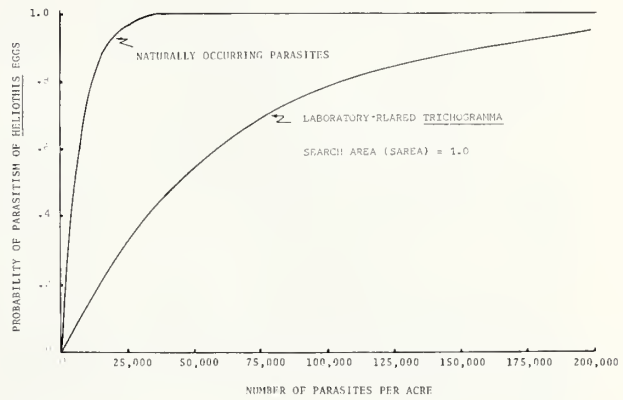



FIGURE 4.—Typical egg parasitism curves generated by model.

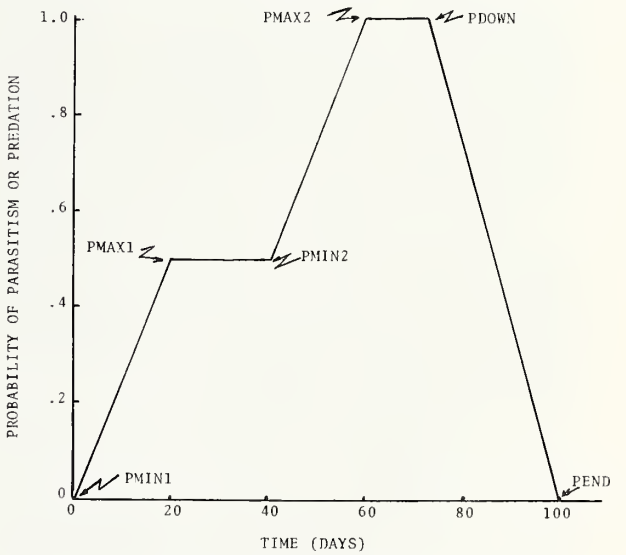



FIGURE 5.—Parasitism or predation curve generated for corn (option 3).

mental temperature. The potential population of *Trichogramma* emerging from parasitized *Heliothis* eggs is calculated and can be used to predict parasitism rates once the population of *Trichogramma* has been initialized.

Egg predators are handled like parasites. Knipling and McGuire's (*10*) model, equation 10, was adapted for egg predators. The value of N is assumed to be 14,500 and 45,000 for native egg predators and laboratory-reared *Chrysopa*, respectively (determined from field data by the Cotton Insects Research Laboratory). Field counts of predators are obtainable and can be used in the model. Egg predators have been placed by the Cotton Insects Research Laboratory into seven groups. The number of predators in each group can be adjusted by a relative efficiency factor, which can be estimated from intuitive and factual knowledge of the predators. The predator groups are *Scymnus*, other Coccinellidae, other Coleoptera, *Orius*, *Geocoris*, other Hemiptera, and *Chrysopa* immatures.

The daily percentage of predation can be used if the number of predators is not available. Also, as described for parasites, the maximum daily rate of predation can be used, and the model will generate daily rates.

The model provides for a daily input of mortality from ovicides for each species. A constant 4.5% daily rate is assumed for mortalities caused by other agents.

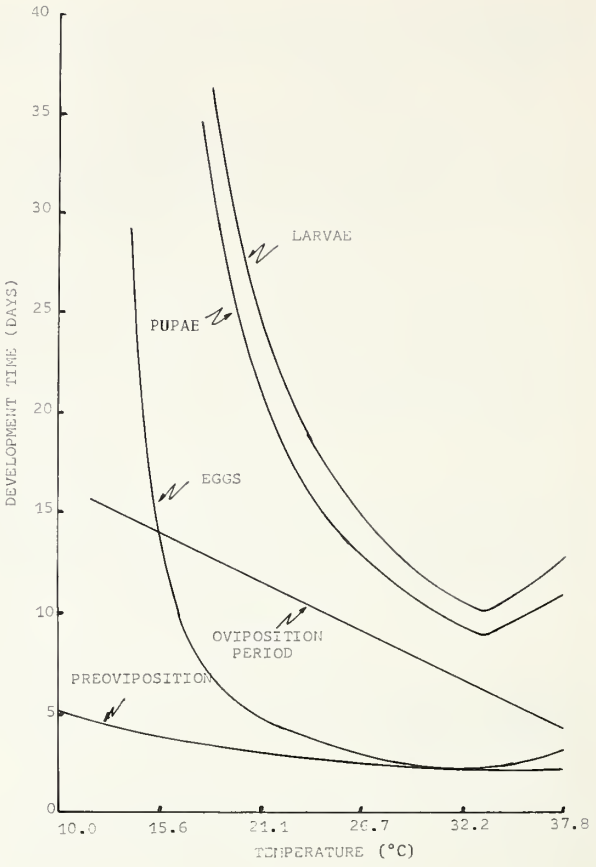



FIGURE 6.—Development time as a function of temperature for *Heliothis* eggs, larvae, pupae, and adults.

## Rate of Egg Development

Researchers have shown that temperature is the major factor regulating the rate of development of *Heliothis* under normal conditions (*2, 6, 8, 12, 21*). Development ceases at temperatures below 12.6° C and is interrupted at temperatures above 33.3° C (fig. 1: G—1).

The 484.9 degree-days required for a complete life cycle of *Heliothis* (*6*) was divided into stages (e.g., eggs and small larvae). It was determined that 40.5 degree-days between 12.6° and 33.3° C were required for development and hatching of eggs. Degree-days above 33.3° C are subtracted from the sum. Figure 6 shows the development time in days required for various temperatures. Hartstack (*6*) and Fye and McAda (*2*) reported a slightly longer time for *H. virescens* than for *H. zea;* therefore, the model is written so that a percentage of reduction or increase can be used.

## Larval Mortality

Knipling (*9*) developed a population model for larval parasites that is, in principle, identical to the *Trichogramma* model discussed earlier. The value of N for larval parasites was assumed to be 300, as suggested by Knipling. Parasitism is applied only to small larvae (first- to third-instar). If numbers of parasites are not available, the daily percentage of parasitism or the maximum daily rate can be used for small larvae. The larval parasitism pattern is calculated exactly as described for egg parasitism (shown in fig. 5).

Knipling and McGuire's (*10*) model, equation 10, was also adapted for predators of small larvae. The value of N was assumed to be 9,000 and 13,000 for native and laboratory-reared *Chrysopa* immatures, respectively (determined from field data by the Cotton Insects Research Laboratory). The daily rate of predation calcu-

lated by equation 10 is reduced in relation to the age of the larvae, as follows:

$$\text{PREDOR}' = (\text{PREDOR}) \exp\left(\frac{(-0.42)(\text{AGE})}{0.657}\right), \quad (11)$$

where PREDOR′=percentage of predation after adjustment for age of larvae,
PREDOR=percentage of predation calculated by equation 10,
and AGE=age of larvae in days.

Larval predators are grouped by the Cotton Insects Research Laboratory into the same groups listed for egg predators. The larval predator numbers are adjusted by estimated relative efficiency factors. Daily percentage of predation of small larvae can be read in if the number of predators is not available. The daily percentage is reduced for age of larvae by equation 11. If the maximum daily rate of predation of small larvae is used, the larval predation pattern is calculated as was described for egg predation (shown in fig. 5), and again the daily percentage is reduced for age of larvae by equation 11.

Mortality of larvae by cannibalism is considered for *H. zea* only (fig. 1: M). Subroutine CROP calculates the number of "sites" available daily for egg laying. Pieters and Sterling (*20*) reported that *H. zea* eggs are distributed in the field as described by the negative bionomial and that the dispersion factor (DF) of the negative bionomial for *H. zea* eggs in cotton is 0.36. Cannibalism of *H. zea* is considered by many to be negligible in cotton but very high in corn, since *H. zea* eggs are concentrated on silks when these sites are available. A dispersion factor of 0.36 is assumed here for corn. The number of sites available is assumed to be the number of plants times the relative search area (SAREA) until silks appear. At that time the number of sites is reduced to the number of silks available, since most eggs are laid on silks when they are available. It is assumed that when silks become 15 days old they are dry and no longer attractive for oviposition. It is also assumed that a larvae reaches the fourth instar before it becomes cannibalistic and destroys all smaller larvae on the same site. Only a small percentage of small larvae will be destroyed in 1 day, but this percentage will increase as the larvae develop and are more active. The number of surviving larvae is determined by

$$\text{PRBLAR}_i = \text{TOTALS3}_i \div \text{SITES}_j, \quad (12)$$

$$\text{ATE}_i = 0.05 + 0.05(\text{AGE}_i), \quad (13)$$

and

$$\text{POP}'_i = \text{POP}_i - (\text{POP}_i)(\text{PRBLAR}_i)(\text{ATE}_i), \quad (14)$$

where $\text{PRBLAR}_i$=probability of a large *H. zea* larva being on a site on day $i$,
$\text{TOTAL3}_i$=number of surviving large *H. zea* larvae on day $i$,
$\text{SITES}_j$=number of sites available for oviposition on day $j$ (day $j$ is the day when the eggs that are being advanced through the simulation were laid),
$\text{ATE}_i$=percentage of small *H. zea* larvae cannibalized on sites with a large larvae on day $i$.
$\text{POP}_i$=the number of small *H. zea* larvae surviving on day $i$ from eggs laid on day $j$,
and $\text{POP}'_i$=the small *H. zea* larvae surviving cannibalism until the next day.

This calculation is done each day until the surviving small larvae laid on day $j$ become large larvae. On the last day of the third instar the probability of more than one surviving small larva being on the same site is calculated, and the population is reduced to one per site by solving

$$\text{XBAR}_i = \text{POP}_i \div \text{SITES}_j, \quad (15)$$

$$\text{PRBNEW}_j = 1 - \left(\frac{\text{DF}}{\text{DF}+\text{XBAR}_i}\right)^{\text{DF}}, \quad (16)$$

and

$$\text{POP}'_i = (\text{SITES}_j)(\text{PRBNEW}_j), \quad (17)$$

where $\text{XBAR}_i$=number of surviving small *H. zea* larvae per site on day $i$,
$\text{PRBNEW}_j$=probability that one or more small larvae are on a site on day $j$,

and DF=dispersion factor of the negative bionomial (0.36).

The model provides for separate inputs of mortalities of small and large larvae from insecticides. A constant daily rate of 4.0% is assumed for mortalities from natural causes.

## Rate of Larval Development

Degree-day figures used for the average development of small larvae (one- to three-instar) and large larvae (four- or five-instar) are 81.7 and 120.6, respectively, calculated as for eggs. Isely (*8*) reported different development times for *H. zea* larvae held at constant temperatures when they were fed various crops and crop parts. Corn ears were apparently the most nutritious, since larval development was significantly faster with this diet. Our unpublished field data at College Station support these results, and this factor has been included in the model. The nutrition factor used for corn plants and for cotton plants and fruit is 1.0. If larvae are developing on corn plants when ears are present, 0.65 is used. The nutrition factor for larvae developing on sorghum is 1.1.

## Pupal Mortality

The only mortality inputs for pupae are a constant natural mortality of 3.0% per day. Mortalities from insecticides can also be used.

## Rate of Pupal Development

Pupae require 123.9 degree-days for development. Figure 6 shows this temperature-time relationship.

## Adult Mortality

Fye and McAda (*2*) and Sterling[4] reported a temperature survival relationship for *Heliothis* moths. Figure 7 shows the probability of survival of adult moths as related to age and temperature. The following equations were developed to describe this survival probability:

$$\text{FACTK}=1.2919+(0.02724)(\text{TEMAVG}), \quad (18)$$

and

$$\text{SURV}=1.0-1.7724\exp\left(\frac{-11.4457}{(\text{FACTK})(\text{L})}\right), \quad (19)$$

where FACTK=temperature constant for exponential equation,
TEMAVG=average air temperature (°F) on day of simulation,
SURV=probability of survival to L age,
and L=age of moth in days.

Survival of moths at temperatures below 20° C is assumed to be the same as at 20° C. Daily mortalities from insecticides can be used for adult moths of both species. Snow et al. (*24*) reported that few moths lived beyond the sixth night after their emergence in the field. To simulate this high mortality, we used a daily rate of 15.0% for mortalities from natural causes.

## Migration

Crop phenological data are used to calculate emigration from corn and sorghum. In corn and sorghum the mature date (IM) is used to start the emigration, which builds to a maximum at the dry date (ID) and then remains constant for the rest of the simulation. The maximum percentage of emigration is read in. These moths are stored and can be used later as immigrants to other crops.

## Duration of Oviposition

Fye and McAda (*2*) and Isely (*8*) showed

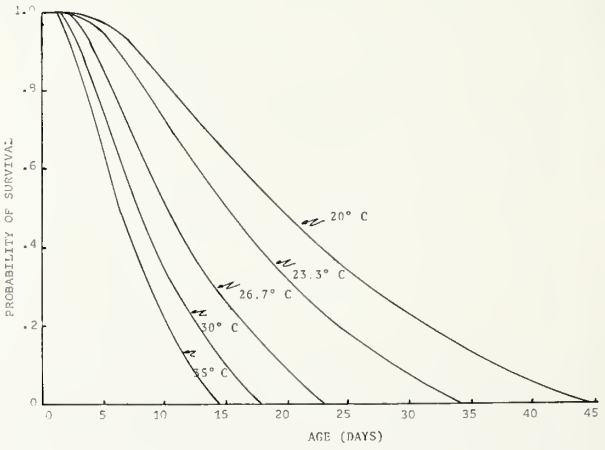



FIGURE 7.—Probability of *Heliothis* moth survival as related to age and temperature.

[4] Winfield L. Sterling, personal communication.

that the duration of oviposition is a function of temperature. We used the following equation to estimate the duration and to terminate it:

$$IGENZV6 = 28.25 - (0.24037)(TEMAVG), \quad (20)$$

where IGENZV6 = length of oviposition period,

and TEMAVG = average air temperature (°F) on day of simulation.

## DESCRIPTION OF SUBROUTINES

### Temperature (TEMP)

All temperature and cloud-cover input and the calculation of degree-days are handled by TEMP (fig. 1: G). There are two options for putting daily temperature in: (1) hourly temperature and (2) daily maximum and minimum temperatures. The hourly temperature takes precedence if the data are available. When maximum and minimum temperatures are used, hourly temperatures are estimated by assuming a consine-wave fluctuation between maximum and minimum readings at 1400 and 0200 hours, respectively.

TEMP calculates the degree-days for corn as well as for *Heliothis*. For example, the degree-days for *Heliothis* are calculated by

$$ED_a = \sum_{X=1}^{24} (T_X - 12.6) - 2(T_X - 33.3) \quad (21)$$

and $$ED_{a'} = ED_a + ED_{a-1} + \ldots + ED_{a-n}, \quad (22)$$

where $ED_a$ = degree-days on day $a$,

$X$ = hour,

$T_X$ = hourly temperature on day $a$ (°C),

$ED_{a'}$ = accumulated degree-days from day $n$ to day $a$, imposing only positive values of $(T_X - 12.6)$ and $(T_X - 33.3)$ be summed,

and $n$ = day number of start of simulation (Julian).

Multiplying $(T_X - 33.3)$ by 2 causes a reduction in degree-days for temperatures above 33.3° C, thereby simulating the retardation of the development of *Heliothis* by high temperatures. Also calculated in TEMP are the accumulated degree-days for corn, sorghum, and cotton, the average daily temperature, the average nightly temperature, the average temperature for the 3 hours after sunset (oviposition temperature), the time of sunrise and sunset, and the percentage of cloud cover during the oviposition period.

### Generation Length (GENLN)

The degree-days calculated in TEMP are used to calculate the number of days required for development of the *Heliothis* (fig. 1: L). The following equation illustrates the GENLN function:

$$D_e = ED'_{a+n} - ED'_a > 40.5, \quad (23)$$

where $D_e$ = degree-days required for development of eggs,

$ED'_{a+n}$ = number of degree-days accumulated to day $a+n$,

$ED'_a$ = number of degree-days accumulated to day $a$,

and $n$ = number of days required for egg development from day $a$.

Also calculated in GENLN are the lengths of the preoviposition and oviposition periods (equations 4 and 22). The development times are also adjusted for the percentaegs of difference between species.

### Moonlight (MOON)

This subroutine calculates the number of days, before or after, that each day of the simulation is from full moon. MOON then stores in the ADMOON array the proper moonlight adjustment factor, $P_4$, for egg laying.

### Insecticides (SPRAY)

This subroutine reads in daily mortalities caused by insecticides for eggs, small larvae, large larvae, pupae, adults, parasites, and predators for each species.

### Parasites (PARINP)

This subroutine calculates parasitism of eggs and larvae as described under "Egg Mortality."

### Predators (PRDINP)

This subroutine calculates predation of eggs and larvae as described previously under "Egg Mortality."

### Adult Moths (ADULT)

This subroutine calculates adult mortality as described previously.

### Crop Phenology (CROP)

This subroutine calculates the various phenological stages, the relative search area, and the number of sites (e.g., ears) for corn. Degree-days as previously described are used to make these predictions.

### Cannibalism (CANBAL)

This subroutine calculates the probability of cannibalism of *H. zea* larvae.

### Migration (MIGRAT)

This subroutine calculates the probability of moths migrating away from a particular crop.

### Field Population (FLDPOP)

This subroutine converts light-trap catches to field populations expressed as moths per acre (*5, 7*). The light-trap catches are adjusted for low night temperatures. Light-trap catches for 5 years (1970–74) were reduced significantly before June 10. The effect of temperature was large early (April) and decreased to nearly zero by June 10. Hardwick (*4*) also found a significant correlation between low night temperatures and light-trap catches. Figure 8 shows the effect of temperature on trap catch on four dates (Julian). We used a quadratic equation to calculate the adjustment for any particular day. The coefficients of the quadratic (A) and the base factor (F=26.7° C) are calculated by four linear equations whose variable is time (Julian date):

$$A1=812.4-5.8(IDY), \quad (24)$$

$$A2=28.6753+0.20281(IDY), \quad (25)$$

$$A3=0.252667-0.001762(IDY), \quad (26)$$

$$F=136.9-0.86667(IDY), \quad (27)$$

$$F'=A1+A2(NA)+A3(NA)^2, \quad (28)$$

and $$TRAPIN=F\div F', \quad (29)$$

where IDY=Julian date,
F′=temperature factor,
NA=average temperature from 1800 to 0600 hours (°F),
and TRAPIN=adjustment factor for trap catch.

This adjustment is limited to the College Station, Tex., climate or a similar one. The time factor would have to be changed for areas where early-season temperatures differ significantly. These equations are only valid to day 153 of the simulation, and all temperatures below 12.8° C are assumed to be 12.8° C.

### Graph (GRAPH)

This subroutine may be used if a graph of the output or input is needed.

### *Heliothis* Population Input (EGGINP)

This subroutine reads in the *Heliothis* populations for initiating the simulation. These populations can be either eggs or moths. White eggs (eggs up to 1 day old) or total eggs can be used as input. The eggs are read in daily. If total eggs is used, EGGINP divides total egg num-

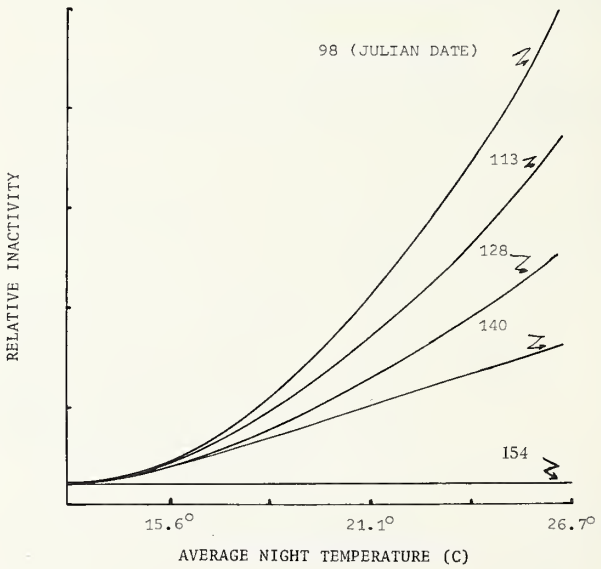



FIGURE 8.—Relative insect inactivity as a function of temperature at different times of the year compared to the inactivity on day 154.

ber by 0.31 to obtain an estimated white-egg count and moves the count to 3 days earlier.

Light-trap catches tabulated by sex or on a total basis can be used as input. Subroutine FLDPOP converts the catch to an estimated number of moths per acre. Male and female moth data are preferred if available because the sex ratio is calculated and used later by CROP to estimate egg-laying probability.

### Double Three-Day Moving Average (SMOOTH)

This subroutine applies a double 3-day moving average to insect population data.

### *Trichogramma* (TRKGRM)

This subroutine is a model of the population dynamics of *Trichogramma*. Development of *Trichogramma* in *Heliothis* eggs is controlled by temperature, and potential parasitism is controlled by number and age of adult *Trichogramma*. These relationships are described by

$$PTEMP_1 = |72 - TEMAVG_i| \quad (30)$$

and $$PTEMP_2 = 1.56 - 0.07(PTEMP_1), \quad (31)$$

where $PTEMP_1$=the degrees average daily temperature is from 72° F, imposing that if $PTEMP_1 > 22$, $PTEMP_1 = 22$ and if $PTEMP_1 < 8$, $PTEMP = 8$,
$PTEMP_2$=the activity factor of adult *Trichogramma* attributable to temperature,

and $$B_1 = -0.693 \div [(N)(SAREA)], \quad (32)$$

and $$B_2 = 1 - \exp[PARSIT(B_1)](PTEMP_2)(1 - POS), \quad (33)$$

where $B_1$=index of potential parasitism,
$B_2$=probability of parasitism,
POS=mortality of parasites from insecticides,
SAREA=relative search area,
and N=number of *Trichogramma* adults required to parasitize 50% of eggs in 3 days (15,000).

The parasitized eggs are subject to death by predators and other natural agents and by insecticides until the *Trichogramma* emerge. It is assumed that the parasites will live 10 days, that two female parasites will emerge from each egg, and that the number of eggs parasitized will increase as a function of search area (to account for eggs missed). The fertility rate of adult *Trichogramma* is read in as array FERATE.

### Function Distribution (DISTR)

DISTR calculates the development distributions of cohorts of eggs, larvae, and pupae. A normal distribution is assumed (*22*). The standard deviations (SDEV) are calculated in subroutine GENLN as a function of temperature (*2*). Array GAUS is the cumulative distribution function for eight standard deviations centered on the mean of the normal probability distribution.

## VALIDATION OF THE MODEL

*Heliothis* populations on corn, sorghum, and cotton were sampled at least two times a week during low populations and three or four times a week during peaks. The samples were taken by examining all plants in 6½ feet of row at six random locations in the field.

Simulations were run from April 1 to July 24, 1974, which covers the first three *Heliothis* generations. The first two *H. zea* generations at College Station oviposit primarily on corn and sorghum, and the third generation oviposits on cotton. It was assumed that the first two generations of *H. virescens* would oviposit primarily on wild hosts and that the third generation would move into cotton. Since no wild hosts were sampled, it was assumed that all eggs found on corn and sorghum were *H. zea*, an assumption verified by laboratory rearing of collected larvae. No counts of parasites or predators were made; therefore, option 3 was used in subroutines PARINP and PRDINP (fig. 5). Two simulations were run and compared with field-collected data.

*Light-trap input.*—Counts of *H. zea* males from two light traps (each having a 40-watt black-light lamp) located in a cornfield were used as model input from April 1 to May 20, 1974. These moths were assumed to have emerged from diapause. The next two generations were predicted and compared with actual field counts. Figure 9 shows the light-trap input converted to total eggs (April 1–May 20), the

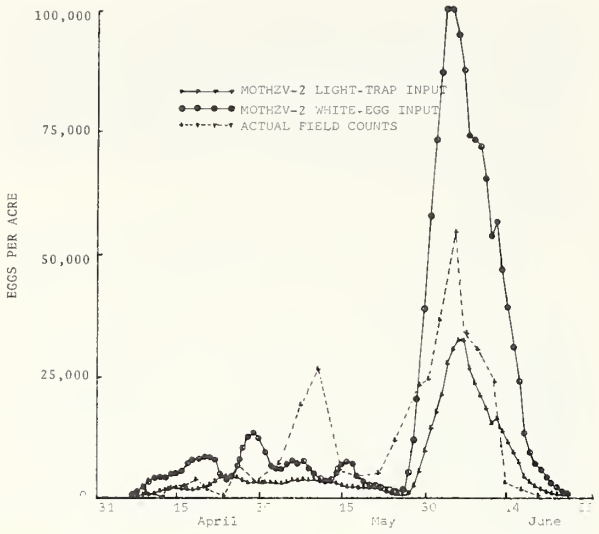



FIGURE 9.—Predicted and actual field counts of eggs. Input to model, April 1 to May 20, 1974.

predicted number of total eggs (May 21–June 29), and the number of eggs counted in the field. Actual hourly temperature was used for the entire simulation. The predicted June peak was 1 day late and the predicted number of eggs was low, the latter caused primarily by the light-trap model, probably one of the weakest parts of MOTHZV–2.

Figure 10 compares the predicted third generation of ovipositing moths migrating into cotton and the actual field count of eggs in cottonfields closest to the cornfield. The predicted moth peak was 3 days ahead of field egg peak, as expected, since eggs would require 2 or 3 days to hatch.

*White-egg input.*—Counts of white eggs in the cornfield from April 1 to May 20 were used as input, and predictions of the next two generations were made. Figure 9 shows the white-egg input and the predicted second generation. The predicted peak was 1 day earlier than the actual peak, and the predicted egg peak was larger than the actual field peak. (Field scouts, bear in mind, are less than accurate. Moreover, many eggs may have been removed by predators before the count.) The predicted third generation moth peak was also 3 days before the actual egg peak in cotton.

Figures 11 and 12 show predicted and actual counts of small and large larvae. The dates of these peaks are very close; however, the magnitudes of the peaks vary similarly to the egg peaks, as discussed. Further validation of assumptions concerning development periods and mortalities could alleviate differences in magnitude. It is felt that the field measurements were in error, even though very competent entomological help was used, because it is impossible to find every egg or larva and because field counts were not made every day. A factor that may affect the size of the small and large larval peaks is the subjective judgment of which group to put them in. The model apparently is

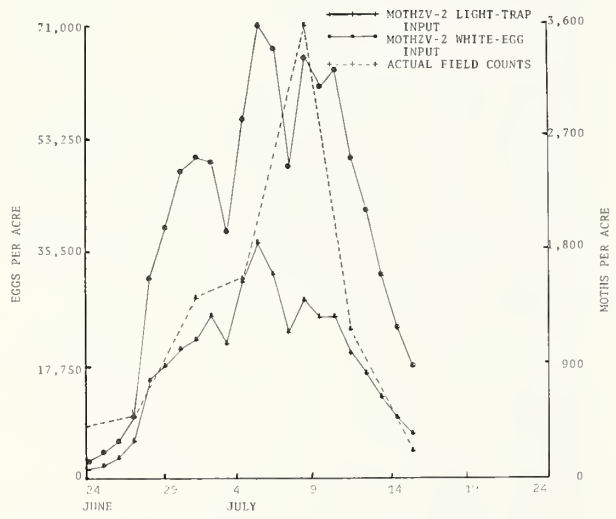



FIGURE 10.—Predicted number of moths migrating from corn and actual field counts of eggs in cotton. Input to model, April 1 to May 20, 1974.

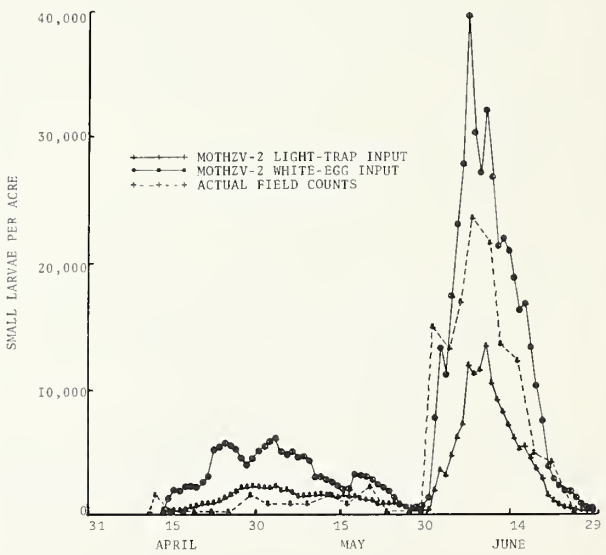



FIGURE 11.—Predicted and actual field counts of small larvae. Input to model, April 1 to May 20, 1974.

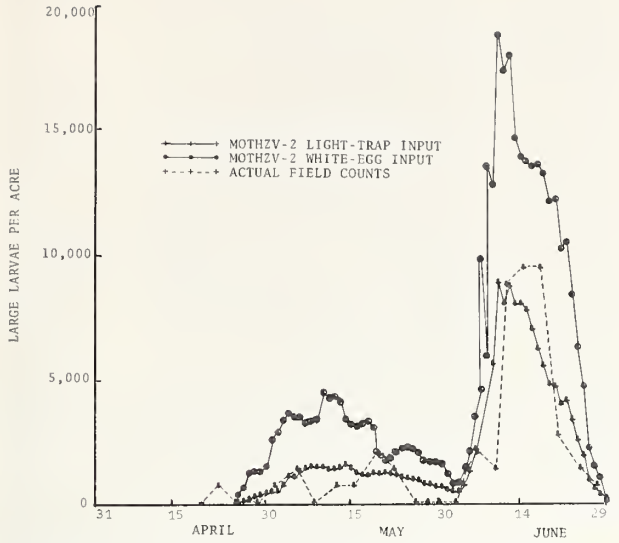



FIGURE 12.—Predicted and actual field counts of large larvae. Input to model, April 1 to May 20, 1974.

dividing them at an earlier age (1 day off) than does the field scout.

Similar results were obtained when data from previous years at College Station and Pearsall, Tex., were used. Simulation of *H. zea* in sorghum was also accomplished with similar results.

# DEFINITION OF TERMS

## Main Program

| | |
|---|---|
| ADMOON | Moonlight adjustment calculated for each day. |
| ADTS | Number of adults migrating on each day of simulation plus the number that migrated and survived previously. |
| ADTSMG | Average number of ovipositing adults that have migrated and survived. |
| AGE | Number of days moth has been ovipositing. |
| AP | Proportion of the eggs not hatched. |
| APARA | Storage of number of eggs parasitized during simulation. |
| APOSON | Storage of number of eggs sterilized from insecticide during simulation. |
| B | Used in calculation of probability of *Trichogramma* parasitism (option 4, KODE 5). |
| BOLLS | Calculated cotton bolls per acre. |
| C | Mortality probabilities. |
| CLOUD | Percentage of cloud cover read in for each hour. |
| DATX | Array of read-in data to be plotted with output. |
| DEATH | Natural mortalities of all stages of insects. |
| DEATHY | Mortality of adults the previous day. |
| DEGDAY | Array of degree-days required for each stage of *Heliothis* development. |
| EARS | Calculated corn ears per acre. |
| ED | Array of degree-days calculated for *Heliothis* development and cotton growth. |
| EDCORN | Array of degree-days calculated for corn and sorghum development. |
| EGGFRT | Percentage of *Heliothis* eggs that are fertile. |
| EGLYCR | Probability that a female will oviposit because of a crop factor. |
| EGLYPR | Probability that a female will oviposit because of crop and temperature factors. |
| EGLYTM | Average temperature (°F) during 3-hour period of maximum oviposition. |
| EGP | Maximum number of eggs a *Heliothis* moth will lay in 1 day. |
| ELPDTA | Probability that a moth is at maximum egg production. |
| EQELAD | Relative number of female moths considered to be ovipositing at maximum rate. |
| FACTAA, FACTBB | Factors for averaging migration of moths from fields of the same crop. |
| FACTD | Calculated light-trap factor to correct trap catch to moths per acre. |
| FM | Array of moonlight adjustment factors. |
| FOODFK | Nutritional factor affecting development time of *Heliothis*. |
| HEADS | Calculated heads of sorghum per acre. |
| IDX | Used for plotting DATX. |
| IEND | Number of days a moth will produce eggs. |
| IFIRST | Day number of first day of simulation (Julian). |
| IFISTT | First day of temperature data to be read in and degree-days calculated (Julian). |
| IFRUIT | Day number first silk appears in corn (Julian). |
| IGEN | Array containing calculated average development times for all stages of *H. zea* and *H. virescens*. |
| IGENV | Array containing calculated average development times for all stages of *H. virescens*. |
| IGENZ | Array containing calculated average development times for all stages of *H. zea*. |
| IGKODE | Plot code. |
| IH | Code for *H. zea*. |
| ILAST | Day number of last day of simulation (Julian). |
| ILASTC | Day number of last day of input to model (Julian). |
| ILASTT | Last day of temperature input and degree-days calculated (Julian). |
| IPEAK | Number of days it takes an ovipositing moth to reach maximum egg production. |
| IPX | Code for double 3-day moving average of migrating moths. |
| ITOP | Number of days moth will be at maximum egg production. |
| IV | Code for *H. virescens*. |
| IXBAR | Mean length of pupal development time in days. |
| JFIRST, JLASTC | Variables to flag feedback of moths. |

| | |
|---|---|
| KKODE | Index of type of input to model (eggs or moths). |
| KODE | Code read in that flags the option wanted. |
| KRUN | Code of a particular simulation. |
| KTRAP | Index of type of input to model (eggs or moths). |
| LLPOP | Temporary storage of field population of 1-day-old large larvae. |
| LX | Mean length of development time for small larvae in days. |
| NITMIN | Average nighttime temperature (°F). |
| NN | Variable used to flag day that simulation is at IFRUIT or past. |
| NPLOT | Plot code. |
| PARSIT | Calculated percentage of parasitism of eggs and larvae for each day of simulation. |
| PCTCRP | Percentage of the area in corn, sorghum, cotton, pasture, and other crops. |
| PCTMG | Maximum percentage of the adult population that would migrate out of the crop on any one day. |
| PDERTE | Predator rating for egg predators. |
| PDLRTE | Predator rating for larval predators. |
| POAPOP | Temporary storage of field population of 1-day-old ovipositing adults. |
| POP | Temporary storage of *Heliothis* eggs. |
| POS | Read-in array containing daily mortality of *Heliothis*, predators, and parasites attributable to insecticide treatments. |
| PP | Temporary storage of field population of 1-day-old larvae. |
| PPOP | Temporary storage of field population of 1-day-old pupae. |
| PRED | Number of predators per acre of the seven groups of predators described in text. |
| PREDOR | Calculated daily percentage of predation of eggs and larvae for each day of simulation. |
| PRMGRT | Calculated percentage of adult population that will migrate on any one day. |
| PTEMP | Used in calculation of probability of *Trichogramma* parasitism (option 4, KODE 5). |
| S | Scale factor 1 for plots. |
| SAREA | Relative plant area searched by *Trichogramma* (arbitrary scale). |
| SDEV | Array of calculated standard deviations of development time for eggs, larvae, and pupae attributable to temperature. |
| SEXRTO | Sex ratio of adults (males+1)/(females+1). |
| SITES | Number of sites available for oviposition. |
| SLPOP | Temporary storage of field population of 1-day-old small larvae. |
| SQUARE | Calculated cotton squares per acre. |
| SRVIVE | Number of fertile eggs remaining in population after all mortalities. |
| SS | Scale factor 2 for plots. |
| T | Total survival probability of small larvae. |
| TCLOUD | Percentage of cloud cover during time of maximum oviposition. |
| TEMAVG | Average air temperature on day of simulation (°F). |
| TINF | Total infertile eggs. |
| TIMEA | Array of expected or measured high and low temperatures. |
| TOTAL | Array for storing total *Heliothis* populations of various stages. |
| TOTMGS | Total number of ovipositing adults that migrate and survive. |
| TOT9 | Percentage of eggs parasitized during simulation. |
| TP | Number of eggs parasitized on any one day. |
| TRUN | Average temperature during oviposition period (°F). |
| TT | Total probability of something surviving. |
| TPP | Number of eggs sterilized on any one day. |
| XBAR | Day number that the mean number of eggs hatch (Julian). |
| XSD | Standard deviation of egg hatch. |

## ADULT

| | |
|---|---|
| FACTK | Temperature effect on adult longevity. |

## CANBAL

| | |
|---|---|
| ATE | Percentage of small *H. zea* larvae cannibalized on sites with a large larvae on a given day. |
| ATEUP | Total number of small *H. zea* larvae cannibalized. |
| CANLAR | Number of small *H. zea* larvae cannibalized by other small larvae. |
| POP | Number of surviving small *H. zea* larvae. |
| PRBLAR | Probability of a large *H. zea* larva being on a site on a given day. |
| PRBNEW | Probability of a small *H. zea* larvae being on a site on a given day. |
| S | Number of sites available for *H. zea* larvae. |
| XBAR | Average number of small larvae per site. |
| XPOP | Total number of small larvae cannibalized from this cohort. |

## CROP

| | |
|---|---|
| A20, A21, A22 | Coefficients for calculating egg-laying probability on corn during silking period. |
| A30, A31, A32, A33 | Coefficients for calculating egg-laying probability on corn before first silk appears. |
| A40, A41, A42 | Coefficients for calculating egg-laying probability on corn after silking period. |
| AM20, AM21, AM22 | Coefficients for calculating egg-laying probability on sorghum after boot stage. |
| AM30, AM31, AM32, AM33 | Coefficients for calculating egg-laying probability on sorghum before boot stage. |

| | |
|---|---|
| DD | Degree-days required for corn or sorghum to develop from IA to peak silk or head. |
| DDA | Degree-days from corn and sorghum emergence to IA. |
| DDB | Degree-days from first square to first boll in cotton. |
| DDF | Degree-days from IA to IF in corn and sorghum. |
| DDM | Degree-days from first boll to maturity in cotton. |
| DELTAX | Percentage of crop development per day. |
| DISTS | Percentage of eggs hatched. |
| IA | Day number when crop becomes attractive to *Heliothis* (Julian). |
| IE | Day number when crop emerges (Julian). |
| IF | Day number when first fruit appears (Julian). |
| IM | Day number when crop becomes fully mature (Julian). |
| IP | Day number when crop planted (Julian). |
| KCROP | Set to value of KODE 11 (crop). |
| NATRAC | Day number when crop becomes attractive to *Heliothis* (Julian). |
| PLANTS | Number of plants per acre. |
| S | Factor used to calculate normal distribution for development of fruit. |
| TP | Factor used to calculate normal distribution for development of fruit. |
| YIELD | Estimated yield of cotton bales per acre. |
| YIELDB | Calculated peak number of bolls. |
| YIELDS | Calculated peak number of squares. |

## DISTR

| | |
|---|---|
| GAUS, GAUS1, GAUS2 | Arrays of accumulated normal distributions used to vary development time of *Heliothis*. |

## EGGINP

| | |
|---|---|
| B | Number of *H. zea* eggs in field on first day of simulation. |
| BFMALE | Number of *H. zea* females. |
| BMALE | Number of *H. zea* males. |
| C | Number of *H. vireseens* eggs. |
| CFMALE | Number of *H. virescens* females. |
| CMALE | Number of *H. vireseens* males. |
| IDD | Used for calculation of missing egg data. |
| L | Set to code of type of input (eggs or moths). |
| X | Adjustment factor for total egg input. |
| XDL1, XDL2 | Used for calculation of missing egg data. |
| XEGG | Used for adjustment of nutritional factor for sorghum. |

## FLDPOP

| | |
|---|---|
| A1, A2, A3 | Coefficients used in temperature adjustment of light-trap catches. |
| E | Efficiency of light trap. |
| F | Base factor used in temperature adjustment of light-trap catches (26.7° C). |
| FD | Average distance (feet) a moth can fly in 1 night. |
| F1 | Factor used in temperature adjustment of light-trap catches. |
| IN | Insect species code. |
| IPX | Code for locating light-trap data for double 3-day moving average. |
| R | Effective radius (feet) of light trap. |

## GENLN

| | |
|---|---|
| A1, A2, A3 | Coefficients for calculation of standard deviations in *Heliothis* development times. |
| EDICK | Accumulated degree-days at start of *Heliothis* development. |
| IGENX | Used in calculation of *Heliothis* development times. |
| IKODE | Flags generation length calculations so that calculation of multiple simulations of same weather data will not be repeated. |
| IN | Insect species code. |
| IX | Used in calculation of *Heliothis* development time. |
| P | Percentage of difference in development time of *H. zea* and *H. vireseens*. |
| X | Standard deviations for 1 day. |

## GRAPH

| | |
|---|---|
| B | Used for calculation of variable format. |
| DIGIT, DIGIT1, DIGIT2, | Arrays used for plotting. |
| INSECT | Array used for plot headings and identification. |
| ISTAGE | Array used for plot headings and identification. |
| ISTG | Used to calculate variable scale factors and printout. |
| K | Used for calculation of variable format. |
| KSTG | Used to calculate variable scale factors and printout. |
| NSCALE | Used to calculate variable scale factors and printout. |
| SCALE | Used to calculate variable scale factors and printout. |
| SXV | Code for *H. vireseens*. |
| SXZ | Code for *H. zea*. |
| SXZV | Code for *H. zea* and *H. vireseens*. |
| SX1 | Used to calculate variable scale factors and printout. |
| VFA | Variable format used to plot data. |
| VFB | Variable format used to plot data. |

## MIGRAT

| | |
|---|---|
| XD | Day number crop becomes completely unattractive to *Heliothis* (Julian). |
| XM | Day number crop becomes mature (Julian). |

## MOON

| | |
|---|---|
| A | Set to day number of first full moon (Julian). |
| B | Day number of simulation (Julian). |
| J | Phase-of-moon code. |

## PARINP

| | |
|---|---|
| B, FX | Used to calculate percentage of parasitism. |
| L | Set to parasitism code (option). |
| N | Number of parasites per acre required to obtain 50% parasitism. |
| OLARPA | Number of naturally occurring parasites of *Heliothis* larvae per acre. |
| OTHERS | Number of naturally occurring parasites per acre. |
| PA | Percentage of maximum parasitism of eggs and larvae. |
| PEND | Last day of parasites in crop (Julian). |
| PDOWN | Start of downtrend of parasites (Julian). |
| PMAXI | First peak of parasites (Julian). |
| PMINI | Start of buildup of parasites (Julian). |
| POTHRS | Probability of parasitism by naturally occurring parasites. |
| PTRICH | Probability of parasitism by *Trichogramma.* |
| TRICH | Number of released *Trichogramma* per acre. |
| X | Probability of egg parasitism. |
| Y | Probability of larval parasitism. |

## PRDINP

| | |
|---|---|
| ALB | Number of lady beetles per acre (specifically for data collected at Pecos, Tex.). |
| CALLOP | Number of callops per acre (specifically for data collected at Pecos, Tex.). |
| CHA | Number of *Chrysopa* adults per acre (specifically for data collected at Pecos, Tex.). |
| CHL | Number of *Chrysopa* larvae per acre (specifically for data collected at Pecos, Tex.). |
| CHRYSP | Number of released *Chrysopa* per acre. |
| HEMP | Number of Hemiptera per acre (specifically for data collected at Pecos, Tex.) |
| IFF, ILL | Used for calculating number of predators when actual counts are not available. |
| NE | Number of egg predators needed per acre to obtain 50% predation when search area = 1.0. |
| NL | Number of larval predators needed per acre to obtain 50% predation when search area = 1.0. |
| OTHEGG | Number of naturally occurring egg predators per acre. |
| OTHLAR | Number of naturally occurring larval predators per acre. |
| PCHRYS | Probability of predation by released *Chrysopa.* |
| POTHRS | Probability of predation by naturally occurring predators. |
| SP | Number of spiders per acre (specifically for data collected at Pecos, Tex.). |
| SPID | Number of spiders per acre. |
| X | Probability of predation of eggs. |
| Y | Probability of predation of small larvae. |
| Z | Probability of predation of large larvae. |

## SMOOTH

| | |
|---|---|
| IP | Factor used in double 3-day moving average. |
| IXF | First day of smoothed data. |
| S | Factor used in double 3-day moving average. |
| SM | Equivalent array used to calculate double 3-day moving average. |

## SPRAY

| | |
|---|---|
| P | Percentage of mortality of *Heliothis* stages, predators, and parasites on any one day. |

## TEMP

| | |
|---|---|
| DAYLN | Number of hours of daylight on each day of simulation. |
| ET | Minimum temperature (°F) for *Heliothis* development. |
| IEGG | First hour of maximum oviposition after sunset. |
| T1 | Minimum temperature (°F) for corn and sorghum development. |
| T2 | Maximum temperature (°F) for corn and sorghum development. |
| TEM | Effective hourly degree-days for *Heliothis.* |
| TEMOVR | Number of degrees hourly temperature (°F) is over 92. |
| THP | Actual or expected daily high temperature (°F). |
| TLP | Actual or expected daily low temperature (°F). |
| TM | Actual or calculated hourly temperature (°F). |

## TRKGRM

| | |
|---|---|
| FERATE | Fertility rate of *Trichogramma.* |
| IAGE | Age of *Trichogramma* adults in days. |
| K | Mean development time for *Trichogramma* in days. |
| TS | Keeps track of number of parasitized *Heliothis* eggs. |
| X | Mortality factor. |

# INPUT REQUIREMENTS

Device 05 or
SYSIN: KODE
FORMAT (20I4)

| KODE | Col. No. | Description |
|---|---|---|
| 1 | 4 | 0 Leaves population input the same as in previous run. |

| | | | |
|---|---|---|---|
| | | 1 | Reads in moths (total number). |
| | | 2 | Reads in eggs (1-day-old). |
| | | 3 | Reads in moths (male and female). |
| | | 4 | Reads in eggs (all ages). |
| | | 5 | Migration used as input. |
| | | 6 | Reads in total eggs with missing data. |
| | | 7 | Reads in 0- to 1-day-old eggs with missing data. |
| 2 | 8 | 0 | Temperature stays the same as in previous run; generation length stays same. |
| | | 1 | Reads in hourly temperature. |
| | | 2 | Temperature stays the same as in previous run; generation length can be changed. |
| | | 3 | Reads in daily maximum and minimum temperature. |

Note: Always read in temperature for at least 1 day before and 30 days after time of simulation of crop or insect.

| | | | |
|---|---|---|---|
| 3 | 12 | 0 | No moonlight effect on insect. |
| | 10–12 | xxx | Day number of first full moon in January (add 1 for leap year). |
| 4 | 16 | 0 | No mortalities from insecticides. |
| | | 1 | Reads in insecticide mortality. |
| | | 2 | Leaves input the same as in previous run. |
| 5 | 20 | 0 | Leaves input the same as in previous run (0 to 1st run). |
| | | 1 | Reads in maximum parasitism. |
| | | 2 | Reads in number of parasites on each day. |
| | | 3 | Reads in percentage of parasitism for each day. |
| | | 4 | Reads in number of *Trichogramma* and generates future populations. |
| 6 | 24 | 0 | Migration not calculated. |
| | | 1 | Migration away from crop. |
| | | 2 | Migration into crop as input. |
| 7 | 26–28 | | Not used. |
| 8 | 32 | 0 | No smoothing of data. |
| | | 1 | Smooths trap catch by a double 3-day moving average. |
| 9 | 36 | 0 | No adjustment in trap catch. |
| | | 1 | Adjusts trap catch to moths per acre. |
| | | 2 | Uses same adjustment as previous run. |
| 10 | 38–40 | xxx | Day number that model should run to. |
| 11 | 44 | 1 | Corn. |
| | | 2 | Sorghum. |
| | | 3 | Cotton. |
| 12 | 48 | 0 | Leaves predator input the same as in previous run. |
| | | 1 | Reads in maximum predation. |
| | | 2 | Reads in number of predators per day. |
| | | 3 | Reads in precentage of predation on each day. |
| | | 4 | Reads in number of predators with incomplete data. |
| 13 | 52 | 0 | Leaves natural mortalities the same as in previous run. |
| | | 1 | Reads in natural mortalities, egg fertility, and the maximum number of eggs per moth per day. |
| 14 | 56 | 0 | Leaves crop phenology the same as in previous run. |
| | | 1 | Reads in crop phenology. |
| 15 | 60 | 0 | Leaves migration the same as in previous run. |
| | | 1 | Calculates migration. |
| 16 | 62 | 0 | Log plot of data. |
| | | 1 | Linear plot of data. |
| | | 2 | No plot. |
| | 63–64 | xx | Number of plots wanted. |
| 17 | 68 | 0 | No cannibalism. |
| | | 1 | Calculates cannibalism of larvae. |
| 18 | 72 | 1 | This run is for *H. zea* and *H. virescens*. |
| | | 2 | This run is for *H. virescens* only. |
| | | 3 | This run is for *H. zea* only. |
| 19 | 76 | 0 | No cloud cover input, clear sky assumed. |
| | | 1 | Input cloud cover and use. |

Device 05 or
SYSIN: Mortalities, egg fertility, and egg laying
KODE (13) = 1 or more
FORMAT (2 (6F4.3, F4.0) )

| Column No. | Description |
|---|---|
| 1–4 | *H. zea*: Natural mortality of eggs (% ÷ 100). |
| 5–8 | *H. zea*: Natural mortality of 1- to 3-instar larvae. |
| 9–12 | *H. zea*: Natural mortality of 4- and 5-instar larvae. |
| 13–16 | *H. zea*: Natural mortality of pupae. |
| 17–20 | *H. zea*: Natural mortality of adults. |
| 21–24 | *H. zea*: Egg fertility. |
| 25–28 | *H. zea*: Maximum number of eggs per female per day. |
| 29–32 | *H. virescens*: Natural mortality of eggs. |
| 33–36 | *H. virescens*: Natural mortality of 1- to 3-instar larvae. |
| 37–40 | *H. virescens*: Natural mortality of 4- and 5-instar larvae. |
| 41–44 | *H. virescens*: Natural mortality of pupae. |
| 45–48 | *H. virescens*: Natural mortality of adults. |
| 49–52 | *H. virescens*: Egg fertility. |
| 53–56 | *H. virescens*: Maximum number of eggs per female per day. |

Device 05 or
SYSIN: Days of population data on device 11
KODE (1) = 1 or more
FORMAT (2I4)

| Column No. | Description |
|---|---|
| 1–4 | First day of initial population data to be read in. |
| 5–8 | Last day of initial population data to be read in. |

Device 05 or
SYSIN: Days of temperature data on device 15 and device 16
KODE: (2) = 1 or 3
FORMAT (2I4)

| Column No. | Description |
|---|---|
| 1–4 | First day of temperature data to be read in and degree-days calculated. |
| 5–8 | Last day of temperature data to be read in and degree-days calculated. |

Note: Reading switches automatically to device 16 when end-of-file encountered on device 15. Sufficient days of input should be allowed for crop growth and multiple-run situations.

Device 05 or
SYSIN: Crop phenology
KODE (14) = 1
FORMAT (4I6, F6.0, I6, 5F3.2)

| Column No. | Description |
|---|---|
| 1–6 | Day number of planting date of crop, IP. |
| 7–12 | Day number of emergence date of crop, IE. |
| 13–18 | Day number when first fruit appeared, IF. |
| 19–24 | Day number when crop became mature, IM. |
| 25–30 | Number of plants per acre. |
| 31–36 | Day number when crop becomes attractive to moths, IA. |
| 37–39 | Percentage of the area in corn. |
| 40–42 | Percentage of the area in sorghum. |
| 43–45 | Percentage of the area in cotton. |
| 46–48 | Percentage of the area in pasture. |
| 49–52 | Percentage of the area in other crops. |

Device 05 or
SYSIN: Maximum parasitism
KODE (5) = 1 or 4
FORMAT (2F6.3)

| Column No. | Description |
|---|---|
| 1–6 | Maximum parasitism of eggs (% ÷ 100). Set to zero if KODE (5) = 4. |
| 7–12 | Maximum parasitism of 1- to 3-instar larvae (% ÷ 100). |

Device 05 or
SYSIN: Maximum predation
KODE (12) = 1
FORMAT (2F6.3)

| Column No. | Description |
|---|---|
| 1–6 | Maximum predation of eggs (% ÷ 100). |
| 7–12 | Maximum predation of 1- to 3-instar larvae (% ÷ 100). |

Device 05 or
SYSIN: Plot control
KODE (16) less than 200
FORMAT (36I2), 1 card required for each plot wanted (10 curves per plot maximum)

[Put a 1 in column indicated for desired plot]

| Scale[1] | Information plotted | Column number | | |
|---|---|---|---|---|
| | | *H. zea* | *H. virescens* | Both spp. |
| 1 | Total eggs ..... | 2 | 26 | 50 |
| 1 | Small larvae (1- to 3-instar) ..... | 4 | 28 | 52 |
| 1 | Large larvae (4- to 5-instar) ..... | 6 | 30 | 54 |

[Put a 1 in column indicated for desired plot]

| Scale[1] | Information plotted | Column number: *H. zea* | *H. virescens* | Both spp. |
|---|---|---|---|---|
| 1 | Pupae | 8 | 32 | 56 |
| 2 | Preovipositing adults | 10 | 34 | 58 |
| 2 | Ovipositing adults | 12 | 36 | 60 |
| 2 | Input data (as adults) | 14 | 38 | 62 |
| 2 | Migrating adults | 16 | 40 | 64 |
| 1 | Parasitized eggs | 18 | 42 | 66 |
| 2 | Predicted ovipositing adults equivalents | 20 | 44 | 68 |
| 1 | Other variable scale (1) | 22 | 46 | 70 |
| 2 | Other variable scale (2) | 24 | 48 | 72 |

[1] 1 based on maximum eggs; 2 based on maximum preovipositing adults.

## Device 05 or SYSIN: KRUN (always required) FORMAT (I3)

KRUN designates the status of additional runs to be made. Values greater than zero indicate that additional runs are to be made, and a value of zero (blank) indicates that the present input is the final run to be made.

If the migration outputs from several runs are to be averaged for input to a second crop, special sequential values should be coded as follows: for corn, 11, 12, 13, . . . 19; for sorghum, 21, 22, 23, . . . 29; for cotton, 31, 32, 33, . . . 39.

KRUN indicates the field number associated with the data following the KRUN card. The value of KRUN for the first data set entered is assigned automatically by the program depending on the crop type selected. For a series of three corn fields and two sorghum fields followed by a cotton field the input sequence would be as follows: corn data 1 with KRUN=12, corn data 2 with KRUN=13, corn data 3 with KRUN=21, sorghum data 1 with KRUN=22, sorghum data 2 with KRUN=31, cotton data with KRUN=0. The average migration from the three corn fields would then be added to the average migration from the sorghum and used as input to the cotton with the proper selection of constants on the KODE cards. If independent multiple runs are to be made, values of KRUN from 1 to 9 should be used. No averaging of output will take place.

## Device 11: Moth or egg input

A. KODE (1)=1: Moth input (initial population=males+females)
FORMAT (I6, 4F6.1), 1 card for each day

| Column No. | Description |
|---|---|
| 1–6 | Day number. |
| 7–12 | *H. zea*: Number of males. |
| 13–18 | *H. zea*: Number of females. |
| 19–24 | *H. virescens*: Number of males. |
| 25–30 | *H. virescens*: Number of females. |

B. KODE (1)=2: Egg input (0- to 1-day-old)
FORMAT (9x, I3, 2F6.0), 1 card for each day

| Column No. | Description |
|---|---|
| 10–12 | Day number. |
| 13–18 | *H. zea*: Number of eggs. |
| 19–24 | *H. virescens*: Number of eggs. |

C. KODE (1)=3: Moth input (initial population=2 times number of males, sex ratio calculated)
FORMAT (I6, 4F6.1), card for each day

Same as A above

D. KODE (1)=4: Egg input (all ages)
FORMAT (9x, I3, 2F6.0)

Same as B above

E. KODE (1)=5: Migration of *H. zea* moths from corn or sorghum or both; moth input of *H. virescens* if KODE (18)=1 or 2
FORMAT (I6, 12x, 2F6.1)

Same as A above; enter zero for *H. zea*.

F. KODE (1)=6: Egg input (all ages) with missing data
FORMAT (18x, 2F6.0, I3), 1 card for each day that data are available; computer will calculate missing days. Cards must be in order by date.

| Column No. | Description |
|---|---|
| 19–24 | *H. zea*: Number of eggs. |
| 25–30 | *H. virescens*: Number of eggs. |
| 37–39 | Day number. |

G. KODE (1)=7: Egg input (0- to 1-day-old) with missing data

Same as F above

## Device 12: Insecticide mortalities FORMAT (I6, 14F4.3), 1 card for each day there is mortality

| Column No. | Description |
|---|---|
| 1–6 | Day number. |
| 7–10 | *H. zea*: Parasites (%÷100). |
| 11–14 | *H. zea*: Predators. |
| 15–18 | *H. zea*: 1- to 3-instar larvae. |
| 19–22 | *H. zea*: 4- and 5-instar larvae. |
| 23–26 | *H. zea*: Pupae. |
| 27–30 | *H. zea*: Adults. |

| | |
|---|---|
| 31–34 | *H. zea*: Eggs. |
| 35–38 | *H. virescens*: Parasites. |
| 39–42 | *H. virescens*: Predators. |
| 43–46 | *H. virescens*: 1- to 3-instar larvae. |
| 47–50 | *H. virescens*: 4- and 5-instar larvae. |
| 51–54 | *H. virescens*: Pupae. |
| 55–58 | *H. virescens*: Adults. |
| 59–62 | *H. virescens*: Eggs. |

## Device 13: Parasites

A. KODE (5) = 2
FORMAT (I6, 3F6.0)

| Column No. | Description |
|---|---|
| 1–6 | Day number. |
| 7–12 | Number of *Trichogramma* released. |
| 13–18 | Number of natural egg parasites. |
| 19–24 | Number of natural larval parasites. |

B. KODE (5) = 3
FORMAT (I6, 2F6.3)

| Column No. | Description |
|---|---|
| 1–6 | Day number. |
| 7–12 | Parasitism of eggs (% ÷100). |
| 13–18 | Parasitism of larvae (% ÷100). |

C. KODE (5) = 4
FORMAT (I6, F6.0)

| Column No. | Description |
|---|---|
| 1–6 | Day number. |
| 7–12 | Number of *Trichogramma*. |

## Device 14: Predators

A. KODE (12) = 2
FORMAT (9X, I3, 6F6.0, 6X, 2F6.0, 6X, F6.0) (Special format for handling 1973–74 Frio County, Tex., data.)

| Column No. | Description |
|---|---|
| 10–12 | Day number. |
| 13–18 | Number of *Scymnus*. |
| 19–24 | Number of other Coccinellidae. |
| 25–30 | Number of other Coleoptera. |
| 31–36 | Number of *Orius*. |
| 37–42 | Number of *Geocoris*. |
| 43–48 | Number of other Hemiptera. |
| 55–60 | Number of *Chrysopa* immatures. |
| 67–72 | Number of spiders. |
| 73–78 | Number of released *Chrysopa*. |

B. KODE (12) = 3
FORMAT (I6, 2F6.2)

| Column No. | Description |
|---|---|
| 1–6 | Day number. |
| 7–12 | Predation of eggs (% ÷100). |
| 13–18 | Predation of larvae (% ÷100). |

C. KODE (12) = 4
FORMAT (6X, 6F5.0, I3) (Special format for handling 1974 Pecos, Tex., data.)

| Column No. | Description |
|---|---|
| 7–11 | Number of spiders. |
| 12–16 | Number of adult lady beetles. |
| 17–21 | Number of other Hemiptera. |
| 22–26 | Number of *Chrysopa* larvae. |
| 27–31 | Number of *Chrysopa* adults. |
| 32–36 | Number of Coleoptera. |
| 37–39 | Day number. |

## Devices 15 and 16: Air temperature

A. KODE (2) = 1: Read from device 15
FORMAT (2X, I3, 3X, 24F3.0): Measured hourly temperature, 1 card per day

| Column No. | Description |
|---|---|
| 3–5 | Day number. |
| 9–11 | Average temperature from 0000 to 0100 hours. |
| 12–14 | Average temperature from 0100 to 0200 hours. |
| .... | ..... |
| 78–80 | Average temperature from 2400 to 0100 hours. |

B. KODE (2) = 3 or end of file on device 15: Read from device 16. Sufficient data corresponding to final day specified for temperature input on SYSIN must be provided.
FORMAT (I3, 2F3.0): Measured high and low for each day.

| Column No. | Description |
|---|---|
| 1–3 | Day number. |
| 4–6 | Measured high temperature for day. |
| 7–9 | Measured low temperature for day. |

## Device 17: Cloud cover

KODE (19) = 1: First and last day read in correspond to temperature data. On end-file condition program uses last data read in for remainder of days of input requested. Final card should show desired cloud conditions accordingly.

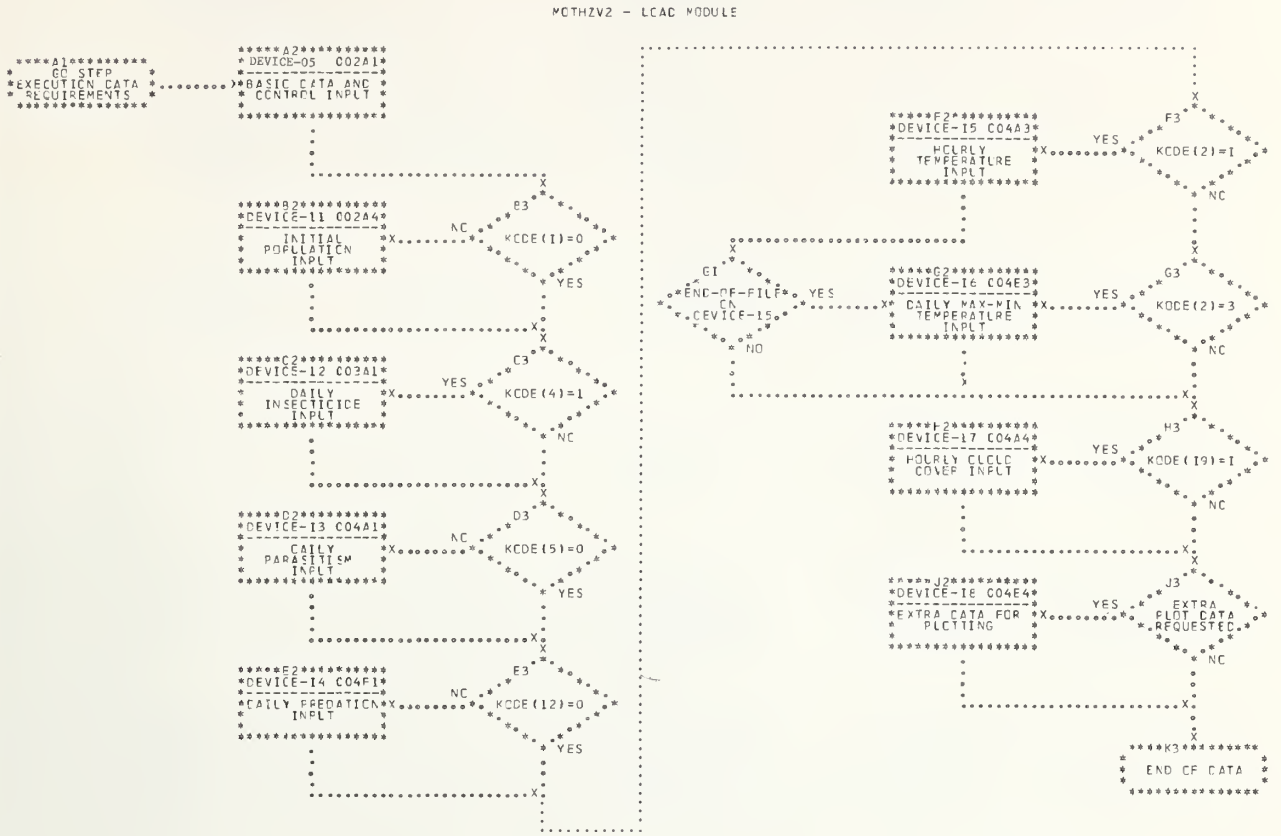
FORMAT (2X, I3, 3X, 24F3.0)

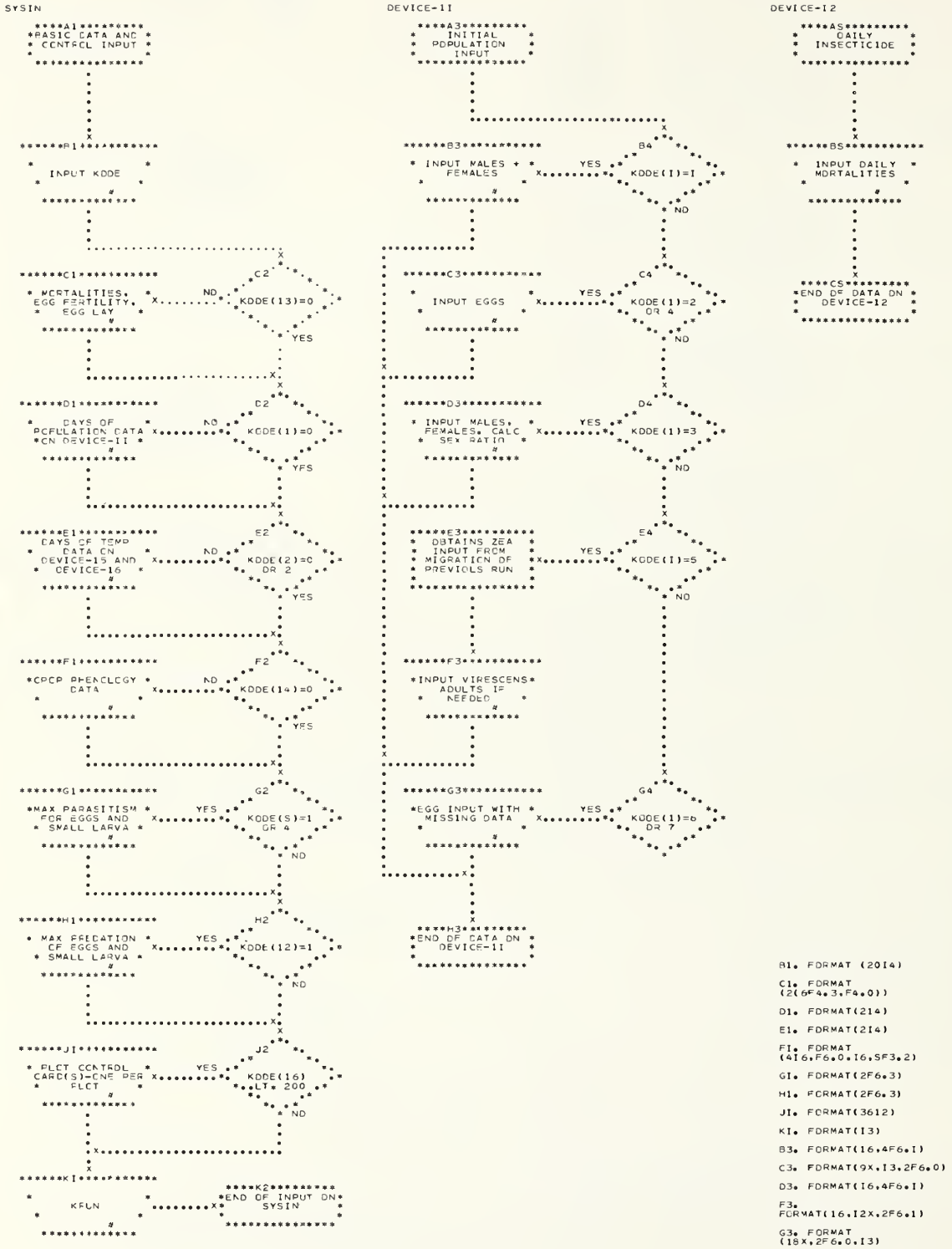
| Column No. | Description |
|---|---|
| 3–5 | Day number. |
| 9–11 | Cloud cover from 0000 to 0100 hours. |
| 12–14 | Cloud cover from 0100 to 0200 hours. |
| .... | ..... |
| 78–80 | Cloud cover from 2400 to 0100 hours. |

Device 18: Extra data to be added to print plot for comparison with model output.

| Column No. | Description |
|---|---|
| 7–12 | Day number. |
| 13–18 | Data value. |

FORMAT (6X, I6, F6.0)






B1. FORMAT (20I4)

C1. FORMAT (2(6F4.3,F4.0))

D1. FORMAT(2I4)

E1. FORMAT(2I4)

F1. FORMAT (4I6,F6.0,I6,5F3.2)

G1. FORMAT(2F6.3)

H1. FORMAT(2F6.3)

J1. FORMAT(3612)

K1. FORMAT(I3)

B3. FORMAT(16,4F6.1)

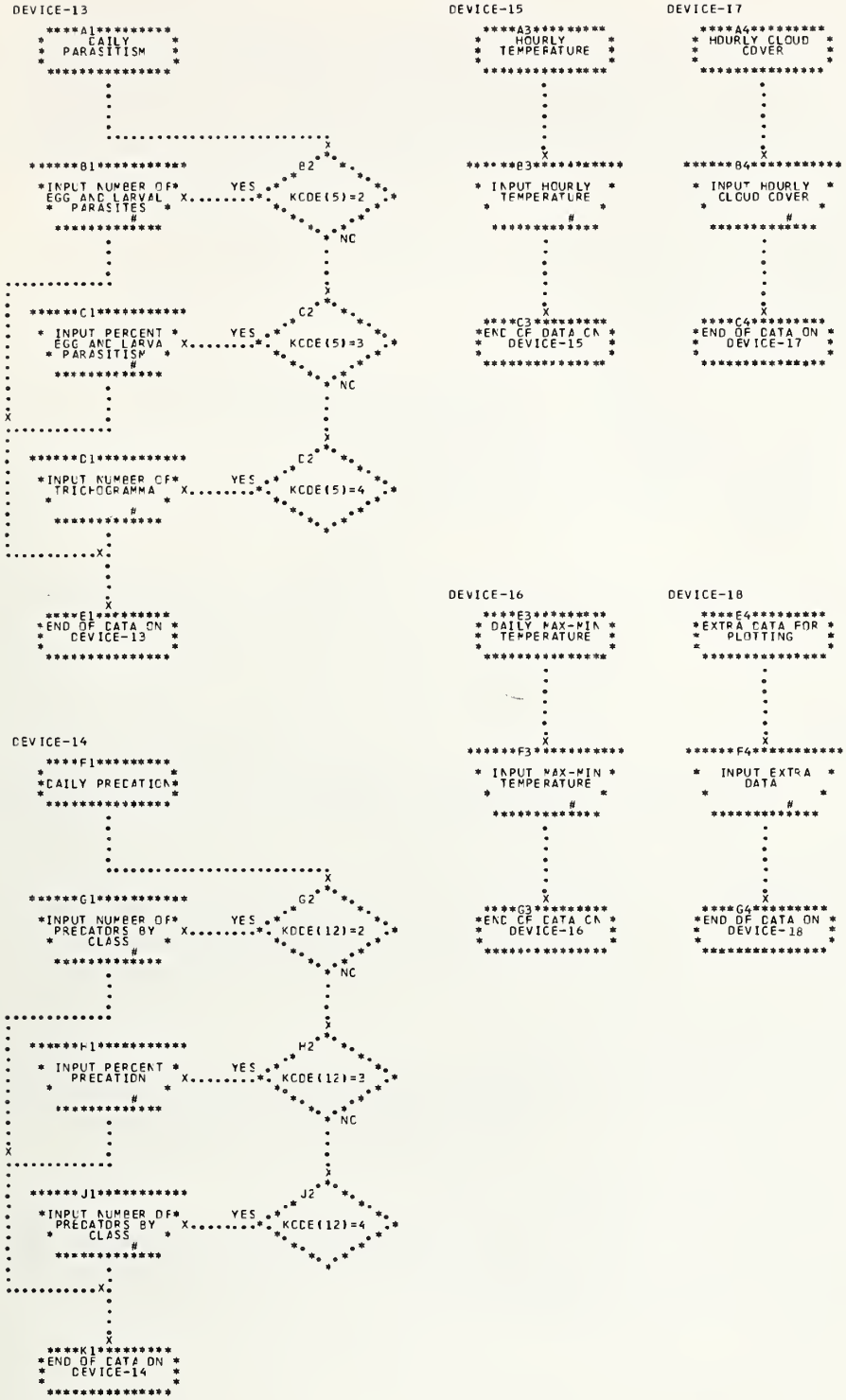
C3. FORMAT(9X,I3,2F6.0)

D3. FORMAT(I6,4F6.1)

F3. FORMAT(16,I2X,2F6.1)

G3. FORMAT (18X,2F6.0,I3)

B5. FORMAT(I6,I4F4.3)




B1. FORMAT(I6,3F6.0)

C1. FORMAT(I6,2F6.3)

D1. FORMAT(I6,F6.0)

G1. FOR FRID CC. DATA
FORMAT(9X,I3,6F6.0,6X,2F6.0,6X,F6.0)

H1. FORMAT(I6,2F6.2)

J1. FOR PECOS DATA
FORMAT(6X,6F5.0,I3)

B3.
FORMAT(2X,I3,3X,24F3.0)

F3. FORMAT(I3,2F3.0)

B4.
FORMAT(2X,I3,3X,24F3.0)

F4. FORMAT(6X,I6,F6.0)

# PROGRAM LISTING

```
    C   MOTHZV 2 MODEL OF  THE HELIOTHIS ZEA AND VIRESCENS BY A. W. HARTSTACK
    C   ROOM 231 AGRICULTURAL ENGINEERING BLDG. USDA ARS COLLEGE STATION,
    C   TEXAS
            REAL NITMIN
            REAL SLPOP(370), LLPOP(370), PPOP(370), POAPOP(370)
            COMMON KODE(20),FACTD,SDEV(370,4),NITMIN(370),ED(370),EDCORN(300),
           ASQUARE(370),BOLLS(370),EARS(370),HEADS(370),S(4),POP(370),EGLYTM(3
           C70),IFIRST,ILASTC,IH,IV,ADMOON(370),SAREA(370),TCLOUD(370),ILAST,
           DKRUN,SEXRTO(370,2),EGPEMT(2),PCTCRP(5),IGEN(370,7,2),TEMAVG(370),
           EEQELAD(370,2),ADTSMG(370,2,2),TOTAL(370,9,2),POS(370,7,2),PARSIT
           F(370,2),PREDOR(370,2),PRMGRT(370,2),IA,IM,L,I,DEATHY,SURV,EGLYPR(
           G370,2),PLANTS,KCROP,IS,SITES(369),R,DF,EGLYCR(370,2),CANLAR,JJ,KK,
           HNN,XPOP,N,PP,IN,K,SRVIVE,X,IPX,IGKODE(12,3),DATX(370),TP,DEATH(5,2
           I),XBAR,XSD,DISTS,IFISTT,ILASTT,IE,PRBLAR,PRBNEW
            DIMENSION SS(2)
            DIMENSION ZZERO(2590),ZONE(16280),ZTWO(740),ZTHREE(1854)
            DIMENSION EGGFRT(2),EGP(2),TOTMGS(370,2),CLOUD(24)
            DIMENSION FM(30)
            DIMENSION PDERTE(7),PDLRTE(7),PRED(7)
            DIMENSION TMEA(800)
            DIMENSION DEAULT(25)
            DIMENSION DEGDAY(6,2)
            DIMENSION ADTS(370,2)
            DIMENSION PCTMG(2)
            DIMENSION SITEQC(370)
            EQUIVALENCE (ZZERO(1),SLPOP(1)),(ZZERO(371),LLPOP(1)),
           D    (ZZERO(741),PPOP(1)),(ZZERO(1111),POAPOP(1)),
           E    (ZZERO(1481),SITEQC(1)),(ZZERO(1851),TOTMGS(1,1))
            EQUIVALENCE (ZONE(1),EQELAD(1,1))
            EQUIVALENCE (ZTWO(1),ADMOON(1))
            EQUIVALENCE (ZTHREE(1),SQUARE(1))
            DO 1 I=1,370
    1       TCLOUD(I)=0.0
    C   INITIALIZE TO ZERO VARIABLES NOT IN COMMON.
            DO 9 I=1,2590
    9       ZZERO(I)=0.0
    C   INITIALIZE TO ZERO VARIABLES EQELAD THRU PRMGRT IN COMMON.
            DO 19 I=1,16280
    19      ZONE(I)=0.0
    C   INITIALIZE TO ONE VARIABLES ADMOON THRU SAREA IN COMMON.
            DO 29 I=1,740
    29      ZTWO(I)=1.0
    C   INITIALIZE TO ZERO VARIABLES SQUARE THRU POP IN COMMON.
            DO 39 I=1,1854
    39      ZTHREE(I)=0.0
    C   KRUN=0 MEANS THE INITIAL SIMULATION. KRUN=1 MEANS GREATER THAN 1-
    C   ADDITIONAL SIMULATION. IFIRST-DAY NO. FIRST DAY OF SIMULATION. ILAST
    C   -DAY NO OF FINAL DAY OF SIMULATION.
            IDX=0
            KRUN=0
    C   KODE-1-20 OPTIONS.
       34   READ(5,500)(KODE(I),I=1,20)
      500   FORMAT(20I4)
            ILAST=KODE(10)
    C   IH-CODE FOR HELICTHIS ZEA- IV CODE FOR HELIOTHIS VIRESCENS.
            IH=1
            IV=2
            IF(KODE(18).EQ.2)IH=2
            IF(KODE(18).EQ.3)IV=1
            IF(KRUN.EQ.0) GO TO 7
            IF(KODE(13).EQ.0) GO TO 37
    C   DEATH-NATURAL MORTALITY FOR EGGS,SMALL LARVAE,LARGE LARVAE,PUPAE,
    C   ADULTS. EGGFRT-FERTILITY OF EGGS. EGPEMT-EGGS PER FEMALE MOTH.
        7   READ(5,506)((DEATH(I,J),I=1,5),EGGFRT(J),EGPEMT(J),J=1,2)
      506   FORMAT(2(6F4.3,F4.0))
            DO 38 I=IH,IV
            EGP(I)=EGPEMT(I)
       38   EGPEMT(I)=EGPEMT(I)/2.
       37   IF(KODE(1).EQ.0) GO TO 60
    C   EGGIMP-SUBROUTINE FOR INPUTING INITIAL POPULATIONS. TOTAL-ARRAY OF
    C   VARIOUS POPULATION STAGES. ILASTC-LAST DAY OF INITIAL INPUT DATA READ
    C   IN. FACTD-LIGHT TRAP CONVERSION FACTOR. ADTSMG-ADULTS MIGRATING
    C   INTO CROP. SEXRTO-SEX RATIO MALES-FEMALES. PCTCRP-PERCENTAGE OF
    C   OVERALL AREA IN EACH CROP SIMULATED.
            READ(5,500) IFIRST,ILASTC
            CALL EGGINP
            IF(KRUN.EQ.0) GO TO 62
       60   KF=IFIRST-1
            DO 61 I=KF,ILAST
            SLPOP(I)=0.
            LLPOP(I)=0.
    61       PPOP(I)=0.
```

```
 83           POAPOP(I)=0.
 84           DATX(I)=0.
 85           DO 61 K=IH,IV
 86           TOTMGS(I,K)=0.0
 87           EQELAD(I,K)=0.0
 88           TOTAL (I,8,K)=0.0
 89           TOTAL(I,9,K)=0.0
 90           DO 61 J=1,6
 91        61 TOTAL (I,J,K)=0.0
 92        62 CONTINUE
 93           IF(KODE(2).EQ.0.OR.KODE(2).EQ.2) GO TO 2
 94     C   READS IN TEMPERATURE
 95     C   TEMP-SUBROUTINE USED TO READ IN TEMP AND OTHER VARIABLES.
 96     C   ED-ACCUMALATED DEGREE DAYS USED FOR INSECT + COTTON- TEMAVG-AVERAGE
 97     C   TEMP PER DAY. EDCORN-ACCUMALATED DEGREE DAYS FOR CORN.
 98     C   EGLYTM-TEMP DURING THE PERIOD WHEN THE MOTH LAYS EGGS.
 99     C   NITMIN-AVERAGE TEMP DURING THE NIGHT- TCLOUD-AVERAGE CLOUD COVER
100     C   DURING THE PERIOD WHEN THE MOTH IS LAYING EGGS.
101           READ (5,500) IFISTT,ILASTT
102           CALL TEMP
103     C   GENLIN-SUBROUTINE USED FOR CALCULATING DEVELOPING TIMES FOR ALL
104     C   STAGES OF INSECT. IGEN- ARRAY OF DEVELOPMENT TIMES FOR VARIOUS STAGES
105     C   OF INSECT. IGENZ- ARRAY OF DEVELOPMENT TIMES FOR HELIOTHIS ZEA.
106     C   IGENV-ARRAY FOR DEVELOPMENT TIMES FOR HELIOTHIS VIR.
107     C   SDEV-STANDARD DEVIATION OF DEVELOPMENT TIMES VARIOUS STAGES.
108     2     CALL GENLN
109     C   CROP-SUBROUTINE FOR CALCULATING CROP PHENOLOGY. EGLYPR-EGGLAY
110     C   PROBABILITY.
111     C   PLANTS-NO. OF PLANTS PER ACRE.
112     C   SQUARE-NO. OF SQUARES PER ACRE.
113     C   BOLLS- NO OF BOLLS PER ACTE.  EARS-  NO OF EARS PER ACRE.
114     C   HEADS- NO OF SORGHUM  HEADS PER ACRE.  KCROP- KODE FOR CROP.
115     C   IA-CODE FOR 1ST ATTRACTNESS OF CROP. IM-DAY WHEN CROP REACHES
116     C   MATURITY.
117     C   SAREA-SEARCH AREA FOR PARASITES AND PREDATORS. IS-DAY NO WHEN CROP
118     C   IS MAX ATTRACTANCE. SITES-NO. OF SITES FOR EGG LAYING.
119     C   DF-DISPERSION FOR NEGATIVE BINOMIAL. EGLYCR-ATTRACTANCE OF CROP FOR
120     C   EGG LAY.
121           CALL CROP
122           IF(KODE(5).EQ.0) GO TO 33
123     C   PARIMP-SUBRCUTINE FOR CALCULATING PARASITIZATION.
124     C   PARSIT-PERCENT PARASITIZATION CALCULATED.
125     32    CALL PARINP
126        33 IF(KODE(12).EQ.0) GO TO 35
127     C   PRDIMP-SUBROUTINE FOR PREDATION INPUT. PREDOR- PERCENT PREDATION
128     C   CALCULATED.
129           CALL PRDINP
130        35 CONTINUE
131         5 IF(KODE(3).EQ.0) GO TO 3
132     C   MOON-SUBROUTINE FOR CALCULATING REDUCTION OF EGG LAY DUE TO
133     C   MOONLIGHT.
134     C   ADMOON-PERCENT REDUCTION OF EGG LAY OF MOONLIGHT CALCULATED.
135           CALL MOON
136         3 CONTINUE
137     C   SPRAY-SUBROUTINE FOR INPUTING INSECTICIDE MORTALITY.
138     C   POS-PERCENT MORTALITY DUE TO INSECTICIDE.
139           CALL SPRAY
140        63 IF(KODE(9).EQ.0) GO TO 36
141     C   FLDPOP-SUBROUTINE FOR CONVERTING LIGHT TRAP CATCH TO MOTHS PER ACRE.
142     C   FACTD-CALCULATED FACTOR FOR CONVERTING LIGHT TRAP CATCH.
143           CALL FLDPOP
144           GO TO 64
145     C   FACTD-EQUALS 1 IF INPUT IS NOT LIGHT TRAP CATCHES.
146        36 FACTD=1.0
147        64 CONTINUE
148     C   NEXT SERIES OF CARDS PRINT OUT READ IN AND CALCULATED INPUT DATA-
149     C   FOR USE IN SIMULATION.
150           IF(KODE(18).EQ.1)WRITE(6,708)
151           IF(KODE(18).EQ.2)WRITE(6,710)
152           IF(KODE(18).EQ.3)WRITE(6,707)
153       707 FORMAT(' INPUT FOR THE MODEL HAS BEEN HELIOTHIS ZEA ONLY')
154       708 FORMAT('  INPUT FOR THE MODEL HAS BEEN HELIOTHIS ZEA AND VIRESCEN'
155          X)
156       710 FORMAT('  INPUT FOR THE MODEL HAS BEEN HELIOTHIS VIRESCEN ONLY')
157           WRITE(6,7070) IFIRST,ILASTC
158      7070  FORMAT(' ',' INPUT READ FROM',I4,' TO ',I4)
159         4 WRITE(6,75)FACTD,KRUN,EGGFRT(1),EGGFRT(2),EGP(1),EGP(2),PLANTS
160        75 FORMAT(' ',2X,'FACTD=',F6.3,2X'RUN NO.=',I3,'ZEA EGGFRT=',F6.3,'VI
161          XRS EGGFRT=',F6.3,/,' ZEA EGGS/MOTH =',F6.0,' VIRS EGGS/MOTH=',F6.0
162          X,'PLANTS/ACRE=',F6.0,/)
163           WRITE(6,7700) IE,IA,IS,IM
164      7700  FORMAT(' ',' CROP PHENOLOGY: IE=',I3,',IA=',I3,',IF=',I3,',IM=',I3/
165          C)
166           WRITE(6,76)
167        76 FORMAT(' DAY NO. EGGPAR 1-3PAR EGGPRD 1-3PRD TCLOUD NITMIN TEMAVG
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      2 ADMOON EGLYTM SQUARES BOLLS  EARS   HEADS  SAREA')
        DO 70 I=IFIRST,ILAST
        WRITE(6,79)I,(PARSIT(I,J),J=1,2),(PREDOR(I,J),J=1,2),TCLOUD(I),NIT
       2MIN(I),TEMAVG(I),ADMOON(I),EGLYTM(I),SQUARE(I),BOLLS(I),EARS(I),HE
       3ADS(I),SAREA(I)
   79 FORMAT(' ',I7,4F7.3,3F7.1,F7.3,F7.1,4F7.0,F7.1)
   70 CONTINUE
        DO 72 IN =IH,IV
        WRITE(6,603)
  603 FORMAT(' ',//,30X,'NATURAL MORTALITY',/,'     EGGS 1-3 LARVAE 4-5 L
     XARVAE    PUPAE',6X,'ADULTS')
        WRITE(6,604) (DEATH(I,IN),I=1,5)
  604 FORMAT(12F10.3)
        WRITE(6,77)
   77 FORMAT('1 DAYNO. PCSPAR POSPRD POS1-3 POS4-5 POSPUP POSADT POSEGG
     2EGG 1-3 4-5 PUP ADP ADU E-E EGLYPR EGLYCR PRMGRT SEXRTO')
        IF(IN.EQ.1)WRITE(6,605)
        IF(IN.EQ.2)WRITE(6,606)
        DO 72 I=IFIRST,ILAST
        WRITE(6,78)I,(POS(I,J,IN),J=1,7),(IGEN(I,J,IN),J=1,7),      EGLYP
       2R(I,IN),EGLYCR(I,IN),PRMGRT(I,IN),SEXRTO(I,IN)
   78 FORMAT(' ',I7,7F7.3,7I4,3F7.3,2F7.2)
   72 CONTINUE
        WRITE(6,81)
   81 FORMAT('      KK      I      SITES  PRBLAR PRBNEW')
  720 CONTINUE
C  IFRUIT-ESTIMATED TO BE 9 DAYS PRIOR TO THE LAST SILKS TO APPEAR.
C  (CORN ONLY)
        IFRUIT=IM-9
        IF(KODE(1).EQ.0) KODE(1)=KKODE
        KKODE=KODE(1)
C  START OF MAIN POPULATION LOOP.
        DO 200 IN =IH,IV
C FOODFK-NUTRIENT VALUE OF CROP CORN LEAVES-1.0-MILO 1.1/ CORN EARS .65
C  COTTON-1.0 FOR ZEA---ALL CROPS 1.0 FOR VIRESCEN
C  FOODFK-VARIABLE USED TO INCREASE OR REDUCE LENGTH OF LARVAE
C  DEVELOPMENT.
        FOODFK=1.1
        IF(KCROP.EQ.1) FOODFK=1.
        IF(IN.EQ.2) FOODFK=1.0
        IF(KCROP.EQ.3) FOODFK=1.0
C  NN-VARIABLE USED TO FLAG WHEN DAY OF SIMULATION IS IFRUIT OR
C  GREATER (CORN ONLY).
        NN=0
        TSITOC=0.
        JFIRST=IFIRST
        JLASTC=ILASTC
C  MAIN POPULATION LOOP.
        DO 200 K=IFIRST,ILAST
  521 CONTINUE
C  KTRAP-CODE NAME OF TYPE OF INPUT.
        KTRAP=KODE(1)
        IF(KODE(6).EQ.2)GO TO 51
        IF(K.GT.ILASTC) GO TO 50
        GO TO (52,520,52,520,8,520,520),KTRAP
        GO TO 8
C  POP NO 0-1 DAY OLD EGGS. EQELAD-NUMBER OF EQUIVALENT EGG LAYING
C  ADULTS.
C  TOTAL-(K,7,IN) INPUT DATA CONVERTED TO MOTHS PER ACRE.
C  K-DAY NUMBER  OF SIMULATION. IN-SPECIES OF INSECT.
C  STATEMENT NO 51 USED ONLY WHEN INPUT IS MIGRATING MOTHS.
   51 POP(K-1)=(EQELAD(K-1,IN)+(TOTAL(K-1,7,IN)*EGLYPR(K-1,IN)))*EGPEMT(
     1 IN)*ADMOON(K-1)
        GO TO 8
C  STATEMENT 50 USED ONLY WHEN DAY OF SIMULATION IS PAST LAST DAY
C  OF INPUT.
C  GENERATED EQELAD IS USED AS INPUT.
   50 POP(K-1)=EQELAD(K-1,IN)*EGPEMT(IN)*ADMOON(K-1)*EGLYPR(K-1,IN)
        GO TO 8
C  STATEMENT 52 IS USED WHEN INPUT IS LIGHT TRAP CATCHES.
   52 POP(K-1)=TOTAL(K-1,7,IN)*EGPEMT(IN)*EGLYCR(K-1,IN)
        GO TO 8
C  STATEMENT 520 IS USED WHEN INPUT IS EGGS.
  520 POP(K-1)=TOTAL(K-1,7,IN)*EGPEMT(IN)
C  APOSON-STORAGE OF NUMBER EGGS STERILIZED FROM INSECTICIDE.
C  APARA-STORAGE OF NUMBER OF EGGS PARASITIZED.
    8 CONTINUE
        APOSON=0
        APARA=0
        TOTPAR=0
        TOTPOS=0
        IF(POP(K-1).LT.1.)GO TO1100
C  XBAR-DAY NUMBER THAT THE MEAN NUMBER OF EGGS HATCHED.  XSD-SDEV-(K,1)
C  STANDARD DEVIATION OF EGGS HATCHED DUE TO TEMPERATURE.
C  DISTS- THE PERCENTAGE OF EGGS HATCHED.
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253           XBAR=K+IGEN(K,1,IN)-1
254           XSD=SDEV(K,1)
255           DISTS=0.
256     C   SRVIVE-NO OF FERTILE EGGS REMAINING IN THE POPULATION AFTER ALL
257     C   MORTALITYS.
258     C   AP-THE PERCENTAGE OF EGGS NOT HATCHED.
259           SRVIVE=POP(K-1)*    EGGFRT(IN)
260           AP=1.
261     C   BEGINNING OF EGG LOOP.
262           DO 100 I=K,ILAST
263           IF(SRVIVE.LT.1.)GO TO 1100
264           C=PREDOR(I,1)*(1.-POS(I,2,IN))
265     C   TT=THE PROBABILITY THAT EGGS WILL SURVIVE NATURAL MORTALITIES AND
266     C   PREDATION. TP=THE NO. OF EGGS PARASITISED-ASSUMES IF OVICIDE APPLIED
267     C   THAT IT WOULD ALSO KILL PARASITE EGG.
268     C   TPP= THE NO. OF EGGS STERILIZED BY OVICIDE
269     C   PARASITISED EGGS ARE ASSUMED TO REMAIN IN FIELD 10 DAYS
270     C   INFERTILE EGGS ARE ASSUMED TO REMAIN IN FIELD FOR 3 - 4 DAYS
271     C   TINF-TOTAL INFERTILE EGGS IN POPULATION.
272           10 TT=(1.-C     )*(1.-DEATH(1,IN))
273           POP(I)=POP(I-1)*TT
274           IF(KODE(5).NE.4)GO TO 1120
275           PTEMP=ABS(72.-TEMAVG(I))
276           IF(PTEMP.GT.22.)PTEMP=22
277           IF(PTEMP.LT.8.)PTEMP=8
278           PTEMP=1.56-.07*PTEMP
279           B=-.693/(1500C.*SAREA(I))
280           B=(1.-EXP(PARSIT(I,1)*B))*PTEMP*(1.-POS(I,1,IN))
281           TP=(POP(I)-APARA)*B*(1.-POS(I,7,IN))
282           CALL TRKGRM
283           GO TO 1121
284      1120 CONTINUE
285           B=PARSIT(I,1)*(1.-POS(I,1,IN))
286           TP=(POP(I)-APARA)*B*(1.-POS(I,7,IN))
287           CALL TRKGRM
288      1121 CONTINUE
289           SRVIVE=SRVIVE*TT*(1.-B     )*(1.-POS(I,7,IN))
290           APARA=(APARA*TT)+TP
291           TPP=POP(I)*POS(I,7,IN)
292           APOSON=(APOSON*TT)+TPP
293           TINF=(POP(I)-APARA)*(1.-EGGFRT(IN))+APOSON
294     C   TOTAL-(I,8,IN)TOTAL NUMBER OF EGGS IN POPULATION ON DAYI.
295           TOTAL(I,8,IN)=TOTAL(I,8,IN)+TINF
296           IF(AP.LT..0001) GO TO 1110
297           X=I
298     C   ZZ-NO OF EGGS THAT HATCHED ON DAY OF SIMULATION.
299           ZZ=SRVIVE*DISTR(DISTS)/AP
300           GO TO 1111
301      1110 ZZ=SRVIVE
302      1111 CONTINUE
303           AP=1.-DISTS
304           POP(I)=POP(I)-ZZ
305     C   SLPOP-NO. OF 1 DAY OLD SMALL LARVAE.
306           SLPOP(I+1)=SLPOP(I+1)+ZZ
307           SRVIVE=SRVIVE-ZZ
308      C  TOTAL-(I,1,IN)TOTAL NO. OF EGGS IN POPULATION ON DAY I. PARENTHIS
309     C   INCLUDING INFERTILE AND PARISITIZED EGGS.
310           TOTAL(I,1,IN)=TOTAL(I,1,IN)+POP(I)-APARA+TP
311        100 CONTINUE
312       1100 CONTINUE
313     C   CHECK TO SEE IF LARVAE IS DEVELOPING ON EARS.
314           IF(KODE(11).EQ.1.AND. K.GE.IFRUIT) FOODFK=.65
315     C SMALL LARVAE ARE EXPOSED TO PARASITES AND PREDATORS FOR ONLY
316     C 2DAYS WHEN SILKS ARE AVAILABLE FOR SITES
317           IF (KODE(11).EQ.1.AND. K.GE.IFRUIT) NN=1
318     C   PP-TEMPORARY STORAGE OF SMALL LAEVAE 0 TO 1 DAY OLD ON DAY K.
319     C   LX-CALCULATION OF APPROX. DAYS REQUIRED FOR DEVELOPMENT OF SMALL
320     C   LARVAE.
321           PP=SLPOP(K)
322           LX=IGEN(K,2,IN)*FOODFK+.5
323           L=K
324           IF(SLPOP(K).LT.1.)GO TO 1201
325     C   XBAR- MEANS DAY NUMBER WHEN SMALL LARVAE BECOMES LARGE LARVAE.
326     C   XSD-SDEV(K,2)STANDARD DEVIATION  FOR SMALL LARVAE DEVELOPMENT.
327     C   DISTS-PERCENTAGE OF SMALL LARVAE THAT HAVE DEVELOPED INTO LARGE
328     C   LARVAE.
329           XBAR=K+LX-1
330           XSD=SDEV(K,2)
331           DISTS=0.
332           SRVIVE=SLPOP(K)
333     C   SRVIVE-TEMPORARY STORAGE OF SMALL LARVAE SURVIVING.
334           AP=1.
335     C   AP-PERCENTAGE OF SMALL LARVAE THAT HAVE NOT DEVELOPED IN TO LARGE
336     C   LARVAE.
337           N=0
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C   N=AGE OF SMALL LARVAE.
      XPOP=0.
C   XPOP=TOTAL NO. OF SMALL LARVAE CANNABILIZED BY LARGER LARVAE.
      CANLAR=0.
C   CANLAR=NO. OF SMALL LARVAE CANNABALIZED BY OTHER LARVAE OF THE SAME
C   SIZE.
C   START OF SMALL LARVAE LOOP.
      DO 101 I=K,ILAST
      IF(SRVIVE.LT.1.)GO TO 1200
      N=N+1
C   CHECK TO SEE IF SMALL LARVAE ARE ON CORN SILKS.
      IF(NN.EQ.1.AND.N.GT.2) GO TO 14
      D    =PARSIT(I,2)*(1.-POS(I,1,IN))
C   EQUATION WHICH REDUCES PREDATION PERCENT LEVEL DUE TO AGE OF SMALL
C   LARVAE.
      E    =(EXP(-.42*N)/.657)*PREDOR(I,2)*(1.-POS(I,2,IN))
      GO TO 13
   14 D=0.
      E=0.
   13 T=(1.-D    )*(1.-E    )*(1.-DEATH(2,IN))*(1.-POS(I,3,IN))
      SRVIVE=SRVIVE*T
      KK=I
C   JJ=CODE TO OPERATE CANNIBALISM SUBROUTINE.
      JJ=365
C   CANNIBAL=SUBROUTINE THAT CALCULATES  CANNIBALISM FOR ZEA LARVAE.
      CALL CANBAL
 1301   X=I
      IF(AP.LT..0001) GO TO 1210
C   ZZ= NUMBER OF SMALL LARVAE THAT HAVE DEVELOPED INTO LARGE LARVAE ON
C   DAY OF SIMULATION.
      ZZ=SRVIVE*DISTR(DISTS)/AP
      GO TO 1211
 1210 ZZ=SRVIVE
 1211 CONTINUE
      AP =1.-DISTS
C   LLPOP=NO OF LARGE LARVAE 0-1 DAY OLD.
      LLPOP(I+1)=LLPOP(I+1)+ZZ
      SRVIVE=SRVIVE-ZZ

C   TOTAL(I,2,IN) TOTAL NUMBER OF SMALL LARVAE IN THE POPULATION ON
C   DAY I.
      TOTAL (I,2,IN)=TOTAL(I,2,IN)+SRVIVE
  101 CONTINUE
 1200 CONTINUE
 1201 CONTINUE
C   LLPOP=LARGE LARVAE POPULATION (0-1 DAY OF AGE).
      SRVIVE=LLPOP(K)
      L=K-LX+1
      IF(L.LT.IFIRST) L=K
C   L ESTIMATES DAY WHEN EGGS WERE LAID ON FRESH SILKS FOR CANABOLISM
C   OF LARGE LARVA.
      JJ=0
      CALL CANBAL
      WRITE(6,600)L,KK,R,PRBLAR,PRBNEW
  600 FORMAT(2I7,F10.0,2F7.3)
      IF(LLPOP(K).LT.1)GO TO 1300
C   IGEN=(K,3,IN) DEVELOPMENT TIME FOR LARGE LARVAE.
C   LX=DEVELOPMENT TIME FOR LARGE LARVAE ADJUSTED FOR NUTRITION.
C   XBAR=DAY NO. WHEN THE MEAN NUMBER OF LARGE LARVAE WILL PUPATE.
C   XSD=STANDARD DEVIATION FOR PUPATION.
C   DISTS=PERCENT OF LARGE LARVAE THAT HAVE PUPATED.
C   AP= PERCENT OF LARGE LARVAE THAT HAVE NOT PUPATED.
      LX=IGEN(K,3,IN)*FOODFK+.5
      XBAR=K+LX-1
      XSD=SDEV(K,3)
      DISTS=0.
      AP=1.
C   START OF LARGE LARVAE LOOP.
      DO 102 I=K,ILAST
      IF(SRVIVE.LT.1.)GO TO 1300
      T=(1.-DEATH(3,IN))*(1.-POS(I,4,IN))
C   T=MORTALITY DUE TO INSECTICIDE AND NATURAL MORTALITY.
C   SRVIVE=NO. OF LARGE LARVAE SURVIVING.
      SRVIVE=SRVIVE*T
      X=I
      IF(AP.LT..0001) GO TO 1310
      ZZ=SRVIVE*DISTR(DISTS)/AP
C   ZZ=NO OF LARGE LARVAE THAT HAVE PUPATED ON DAY OF SIMULATION.
      GO TO 1311
 1310 ZZ=SRVIVE
 1311 CONTINUE
      AP =1.-DISTS
C   PPOP=NO.OF PUPAE.
      PPOP(I+1)=PPOP(I+1)+ZZ
      SRVIVE=SRVIVE-ZZ
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C  TOTAL-(I,3,IN) TOTAL NO. OF LARGE LARVAE IN THE POPULATION, ALL AGES
C  ON DAY OF SIMULATION.
      TOTAL(I,3,IN)=TOTAL(I,3,IN)+SRVIVE
  102 CONTINUE
C  SRVIVE-NO. OF PUPAE (0-1 DAY OLD)
 1300 SRVIVE=PPOP(K)
      IF(PPOP(K).LT.1)GO TO 1400
C  IXBAR-XBAR- DAY NO. WHEN THE MEAN NUMBER OF PUPAE BECOME ADULTS.
C  XSD-STANDARD DEVIATION OF EMERGING ADULTS.
C  DISTS-PERCENT OF PUPAE THAT HAVE EMERGED.
C  AP- PERCENT OF PUPAE THAT HAVE NOT EMERGED.
      IXBAR=K+IGEN(K,4,IN)-1
      XBAR=IXBAR
      XSD=SDEV(K,4)
      DISTS=0.
      AP=1.
C  START OF PUPAE LOOP.
      DO 103 I=K,ILAST
      IF(SRVIVE.LT.1.)GO TO 1400
C  SRVIVE-NO. OF PUPAE SURVIVING MORTALITYS.(INSECTICIDE + NATURAL)
      SRVIVE=SRVIVE*(1.-DEATH(4,IN))*(1.-POS(I,5,IN))
      X=I
      IF(AP.LT..0001) GO TO 1410
C  ZZ- NO. OF PUPAE THAT HAVE EMERGED ON DAY OF SIMULATION.
      ZZ=SRVIVE*DISTR(DISTS)/AP
      GO TO 1411
 1410 ZZ=SRVIVE
 1411 CONTINUE
      AP =1.-DISTS
      SRVIVE=SRVIVE-ZZ
C  POAPOP-NO. OF PRE-OVIPOSITIONING ADULTS.(0-1 DAY OF AGE).
      POAPOP(I+1)=POAPOP(I+1)+ZZ
      TOTAL(I,4,IN)=TOTAL(I,4,IN)+SRVIVE
C  TOTAL-(I,4,IN)TOTAL NO. OF PRE OVIPOSITIONING ADULTS ALL AGES IN
C  POPULATION.
  103 CONTINUE
 1400 CONTINUE
C  JJ-DAY NO. WHEN THE MEAN NUMBER OF PRE-OVIPOSITIONED MOTHS BECOME
C  OVIPOSITIONED ADULTS.
      JJ=K+IGEN(K,5,IN)
      IF(POAPOP(K).LT.1.)GO TO 202
      IF(JJ.GT.ILAST) JJ=ILAST
C  SRVIVE-NO.OF PRE-OVIPOSITIONING ADULTS(0-1 DAY OF AGE).
C  L- AGE COUNTER OF ADULTS.
C  DEATHY-MORTALITY OF ADULTS FROM PREVIOUS DAY.
      SRVIVE=POAPOP(K)
      L=1
      DEATHY=0.0
C  ADTS- NO. OF ADULTS MIGRATING ON DAY OF SIMULATION PLUS THE NUMBER
C  OF ADULTS THAT HAVE MIGRATED AND SURVIVED FROM THE PREVIOUS DAY FOR
C  THIS PARTICULAR CHORT.
      ADTS(K-1,IN)=0.0
C  START OF PRE-OVAPOSITIONING LOOP.
      DO 104 I=K,JJ
C  ADULT-SUBROUTINE USED FOR CALCULATIONS FOR NATURAL MORTALITY DUE TO
C  TEMPERATURE.
C  SURV-PERCENT SURVIVED TO THE NEXT DAY.
      CALL ADULT
      SRVIVE=SRVIVE*SURV     *(1.-DEATH(5,IN))*(1.-POS(I,6,IN))
      IF(KODE(6).EQ.0)GO TO 1041
      IF(KODE(11).EQ.3) GO TO 1041
C THIS REDUCES THE NUMBER OF ADULTS IN CROP EACH DAY BY THE PERCENT
C  PROBABLITY THAT THEY HAVE MIGRATED AWAY.
      ADTS(I,IN)=ADTS(I-1,IN)*SURV     *(1. -DEATH(5,IN))+SRVIVE    *PRMG
     1RT(I,IN)
C  ADTSMG-TOTAL NO. OF ADULTS THAT HAVE MIGRATED FROM A PARTICULAR CROP
C  ON DAY OF SIMULATION.(ALL AGES)
      ADTSMG(I,KCROP,IN)=ADTSMG(I,KCROP,IN)+ADTS(I,IN)
      SRVIVE=SRVIVE*(1-PRMGRT(I,IN))
 1041 CONTINUE
C  TOTAL-(I,5,IN) TOTAL NO OF PRE-OVIPOSITIONED ADULTS ON DAY OF
C  SIMULATION. (ALL AGES)
      TOTAL(I,5,IN)=TOTAL(I,5,IN)+SRVIVE
  104 L=L+1
      LL=L-1
C  T-TEMPERATURE SUM OF RUNNING AVERAGE.
C  AGE-LENGTH OF TIME MOTH IS BEING OVIPOSITIONED.
      T=0.
      AGE=0.
      KK=JJ+1
      IF(KK.GT.ILAST)GO TO 202
C  JJ-MEAN LENGTH OF OVIPOSITIONING PERIOD.
      JJ=JJ+IGEN(K,6,IN)
      IF(JJ.GT.ILAST)JJ=ILAST
C  START OF OVAPOSITIONED LOOP.
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508           DO 105 I=KK,JJ
509           AGE=AGE+1.0
510           T=T+TEMAVG(I)
511       C  TRUN-RUNNING DAILY AVERAGE TEMPERATURE.
512           TRUN=T/AGE
513           IF(TRUN.LT.55.)GO TO 1052
514       C  IPEAK-NO. OF DAYS IT TAKES AN OVIPOSITIONING MOTH TO REACH MAX.EGG
515       C  PRODUCTION.
516           IPEAK=(3029282.9*(TRUN )**(-3.111))+.4
517           IF(L.LT.IPEAK)GO TO 1053
518       C  ITOP-NO. OF DAYS MOTH WILL BE AT MAX PRODUCTION OF EGGS.
519           ITOP=(239741.3*(TRUN )**(-2.615402))+.5
520           IPEAK=IPEAK+ITOP
521           IF(L.LE.IPEAK)GO TO 1054
522       C  IEND-NO. OF DAYS AN OVIPOSITIONING MOTH WILL PRODUCE EGGS.
523           IEND=(91C998.7*(TRUN )**(-2.53))+.5
524           IF(L.GE.IEND)GO TO 1052
525           XS=L-IPEAK
526           XB=IEND-IPEAK
527       C  ELPDTA-PROBABILITY THAT A MOTH IS AT MAX. EGG PRODUCTION.
528           ELPDTA=1.-XS/XB
529           GO TO 1060
530        1052 ELPDTA=0.0
531           GO TO 1060
532        1053 XS=L-LL
533           XF=IPEAK-LL
534           ELPDTA=XS/XF
535           GO TO 1060
536        1054 ELPDTA=1.0
537           GO TO 1060
538       C  REDUCES PROBABILITY OF MAX PRODUCTION OF EGGS EFFECTED BY MOONLIGHT.
539        1060 ELPDTA=ELPDTA
540           CALL ADULT
541           SRVIVE=SRVIVE*SURV     *(1.-DEATH(5,IN))*(1.-POS(1,5,IN))
542           IF(KODE(6).EQ.0) GO TO 1051
543           IF(KCROP.GT.2) GO TO 1051
544           ADTS(I,IN)=ADTS(I-1,IN)*SURV     *(1.-DEATH(5,IN))+SRVIVE  *PRMGRT(
545          2I,IN)
546           ADTSMG(I,KCROP,IN)=ADTSMG(I,KCROP,IN)+ADTS(I,IN)
547       C  TOTMGS-TOTAL NO. OF OVIPOSITIONING ADULTS THAT HAVE MIGRATED AND
548       C  SURVIVED.
549           TOTMGS(I,IN)=TOTMGS(I,IN)+ADTS(I,IN)*ELPDTA
550           SRVIVE=SRVIVE*(1.-PRMGRT(I,IN))
551        1051 CONTINUE
552       C  EQELAD-EQUIVILANT EGG LAYING ADULTS (TOTAL NO. OF OVIPOSITIONING
553       C  ADULTS.
554       C  REMAINING IN CROP,ADJUSTED FOR EGG LAY POTENTIAL AND MOONLIGHT)
555           EQELAD(I,IN)=EQELAD(I,IN)+SRVIVE*ELPDTA
556       C  TOTAL-(I,6,IN)TOTAL NO. OF OVIPOSITIONING ADULTS IN POPULATION -
557       C  ALL AGES ON DAY OF SIMULATION.
558           TOTAL(I,6,IN)=TOTAL(I,6,IN)+SRVIVE
559          105 L=L+1
560          202 IF(KODE(7).NE.K) GO TO 200
561          605 FORMAT(' ',25X,'BOLLWORM HELIOTHIS ZEA')
562          606 FORMAT(' ',25X'TOBACCO BUDWORM HELIOTHIS VIRESCENS')
563          200 CONTINUE
564       C  PRINTOUT OF ALL POPULATION  TOTALS.
565           DO 1070 IN=IH,IV
566           WRITE(6,608)
567          608 FORMAT('1',25X,'PRINTOUT OF TOTAL POPULATION OF VARIOUS LIFE STAGE
568             *S ON ANY DAY')
569           IF(IN.EQ.2) GO TO 1071
570           WRITE(6,605)
571           GO TO 1072
572        1071 WRITE(6,606)
573        1072 WRITE(6,610)
574          610 FORMAT('  DAY NO.  EGGS 1ST-3RD 4TH-5TH   PUPAE P ADULT O ADULT
575             2INPUT  EQELAD MIGRATS IN EGGS PAR EGG  TOTMGS  TRICHS')
576           IF(KCROP.GT.2)KCROP=2
577           FACTBB=KRUN-(KCROP*10.)-1.
578           FACTAA=FACTBB/(FACTBB+1.)
579           FACTBB=FACTBB+1.
580           DO 107 K=IFIRST,ILAST
581           IF(KRUN.LT.11) GO TO 1076
582           ADTSMG(K,KCROP,IN)=ADTSMG(K,KCROP,IN)*FACTAA+TOTMGS(K,IN)/FACTBB
583           GO TO 1077
584        1076 ADTSMG(K,KCROP,IN)=TOTMGS(K,IN)
585        1077 CONTINUE
586           IF(KODE(16).GE.200) GO TO 1073
587           IF(S(IN).LT.TOTAL(K,1,IN))S(IN)=TOTAL(K,1,IN)
588           IF(S(IN+2).LT.TOTAL(K,7,IN))S(IN+2)=TOTAL(K,7,IN)
589           IF(S(IN+2).LT.EQELAD(K,IN)) S(IN+2)=EQELAD(K,IN)
590           IF(S(IN+2).LT.ADTSMG(K,KCROP,IN)) S(IN+2)=ADTSMG(K,KCROP,IN)
591        1073 CONTINUE
592           TOT9          =(TOTAL(K,9,IN)/(TOTAL(K,1,IN)+1.))*100.
```

```
      WRITE(6,602)K,(TOTAL(K,J,IN),J=1,7),EQELAD(K,IN),ADTSMG(K,KCROP,IN
     1),TOTAL(K,8,IN),TOT9,TOTMGS(K,IN),PARSIT(K,1)
  602 FORMAT(' ',I5,12F8.0,F8.1,F8.0)
      TOTAL(K,8,IN)=ADTSMG(K,KCROP,IN)
  107 CONTINUE
      IF(IN.EQ.2) GO TO 1070
      IPX=13
C  SMOTH-SUBROUTINE FOR APPLYING 3 DAY MOVING AVERAGE TO ADULTS THAT
C  HAVE MIGRATED.
      ILASTC=ILAST
      CALL SMOOTH
 1070 CONTINUE
      IF (KODE(16).GE.200)GO TO 1075
C  SETS FLAGS FOR PLOT OF DATA.
      IF(KODE(16).GE.100) NPLOT=KODE(16)-100
      IF(KODE(16).LT.100) NPLOT =KODE(16)
      DO 1074 I=1,NPLOT
      READ(5,510)((IGKODE(J,K),J=1,12),K=1,3)
  510 FORMAT(36I2)
      K1=11
      K2=12
      DO 1082 K=1,3
      DO 1081 J=K1,K2
      IF(IGKODE(J,K).EQ.0) GO TO 1081
      IF(IDX.EQ.0) GO TO 552
      DO 1083 KJ=IFIRST,ILAST
C  DATX-ARRAY FOR STORING FIELD DATA OF INSECT POPULATION WANTED ON
C  PLOT TO COMPARE TO SIMULATED WEATHER.
 1083 DATX(KJ)=0.
      IDX=1
552   READ(18,551,END=1081)ID,X
  551 FORMAT(6X,I6,F6.0)
      IF(ID.EQ.0) GO TO 1081
      DATX(ID)=X
      GO TO 552
 1081 CONTINUE
 1082 CONTINUE
C  GRAPH-SUBROUTINE FOR PLOTTING VARIOUS STAGES FOR INSECT POPULATION.
      CALL GRAPH
 1074 CONTINUE
 1075 CONTINUE
C  CHECK TO SEE IF THIS IS LAST SIMULATION WITH INSECT POPULATION.
      READ(5,550,END=1085) KRUN
  550 FORMAT(I3)
      IF(KRUN.EQ.0) STOP
      DO 1080 I=1,4
 1080 S(I)=0.0
      GO TO 34
 1085 STOP
      END
```

```
      SUBROUTINE ADULT
C  THIS SUBROUTINE CALCULATES MORTALITY RATES FOR ADULTS AS DESCRIBED
C  IN TEXT.
      COMMON KODE(20),DUM60(11788),TEMAVG(370),DUM61(16282),L,I,DEATHY,
     ASURV,SADULT(2286)
      IF(TEMAVG(I).LT.68.) GO TO 103
      FACTK=-1.2919+.02724*TEMAVG(I)
      GO TO 102
  103 FACTK=.56
C FACTK=1.22-92, 1.00-86, .806-77, .560-68
  102 DEATHX=1.7724*EXP(-11.4457/(FACTK*L))
      IF(L.EQ.1) GO TO 101
      DEATHY=1.7724*EXP(-11.4457/(FACTK*(L-1)))
  101 SURV    =(1.-DEATHX)/(1.-DEATHY)
      RETURN
      END
```

```
      SUBROUTINE CANBAL
C  THIS SUBROUTINE CALCULATES THE PROBABILITY OF CANNIBALISM OF H. ZEA
C  LARVAE.
      COMMON DUM48(3281),EARS(370),DUM49(10747),TOTAL(370,9,2),DUM50(740
     A2),KK,DUMB(744),KCROP,DUM51,SITES(369),S,DF,DUM52(740),CANLAR,JJ,I
     B,NN,XPOP,N,PP,DUM54(2),POP,SCANB(425),PRBLAR,PRBNEW
C NN EQUAL 1 WHEN CROP IS CORN AND SILKS ARE PRESENT
      S=SITES(KK)
      IF(NN.EQ.1)S=EARS(KK  )-EARS(KK-15)+1.
      IF(JJ.EQ.0)GO TO 200
C ESTIMATION OF PROBABILITY OF A LARGER(4-5 INSTAR) LARVAE BEING PRESENT
```

```
C ON A FEEDING SITE ON DAY I
      PRBLAR=TOTAL(I,3,1)/S
      IF(PRBLAR.GT.1.)PRBLAR=1.
      ATE=.05+.05*N
      ATEUP=PRBLAR*POP*ATE
      POP=POP-ATEUP
      XPOP=XPOP+ATEUP
      IF (I.LT.JJ)RETURN
  200 IF(POP.LT.1.)GO TO 1
      F=POP
      XBAR=POP/S
      DF=.36
      PRBNEW=1.-(DF/(DF+XBAR))**DF
      CANLAR=POP-S*PRBNEW
      POP=POP-CANLAR
    4 CONTINUE
C ASSUMES THAT ONLY 1 LARGE LARVAE WILL SURVIVE PER SITE
      PRBNEW=CANLAR/P
      GO TO 5
    1 PRBNEW=0.
    5 IF(PP.LT.1.) GO TO 6
      PRBLAR=XPOP/PP
      GO TO 2
    6 PRBLAR=0.
    2 CONTINUE
      RETURN
      END



      SUBROUTINE CROP
C   THIS SUBROUTINE CALCULATES THE VARIOUS PHENOLOGICAL STAGES, THE
C   RELATIVE SEARCH AREA,AND NUMBER OF SITES (E.G.,EARS)FOR CORN. DEGREE
C   -DAYS AS DESCRIBED ARE USED TO MAKE THESE CALCULATIONS.
      COMMON KODE(20),DUM15(1851),ED(370),EDCORN(300),SQUARE(370),BOLLS
     A(370),EARS(370),HEADS(370),DUM16(374),EGLYTM(370),IFIRST,ILASTC,IH
     B,IV,DUM17(370),SAREA(370),DUMA(370),ILAST,KRUN,SEXRTO(370,2),
     CDUM18(2),PCTCRP(5),IGENZ(370,7),DUMI(2590),TEMAVG(370),DUM19(15540
     D),PRMGRT(370,2),IA,IM,DUM20(4),EGLYPR(370,2),PLANTS,KCROP,IF,SITES
     E(370),DF,EGLYCR(370,2),DUMMY(7),IN,K,DUMMY2,X,DUMMY3(423),IE
      DATA A20,A21,A22/-40.6667,83.3333,-41.6667/
      DATA A30,A31,A32,A33/.2,1.522,-2.8977,1.4394/
      DATA AM30,AM31,AM32,AM33/.2,1.09554,-1.13822,.19044/
      DATA AM20,AM21,AM22/-17.5,37.0,-18.5/
      DATA A40,A41,A42/4.34331,-5.41664,1.6927/
      KCROP=KODE(11)
      IF(KCROP.EQ.1) DD=1240
      IF(KCROP.EQ.2) DD=1390.
      DDA=205.
      IF(KCROP.NE.3)GO TO 66
      DDA=681.
      DDB=570.
      DDM=1130.
C YIELD=1.5
C ASSUME 44% LOSS OF SQUARES AND 10% LOSS OF BOLLS
      YIELD=1.5
      YIELDS=YIELD*7000000.
      YIELDB=YIELD*7600000.
      YIELDT=400000*YIELD*.8
   66 CONTINUE
      IF(KRUN.EQ.0) GO TO 8
      IF(KODE(14).EQ.0) RETURN
    8 READ(5,500)IP,IE,IF,IM,PLANTS,NATRAC,(PCTCRP(I),I=1,5)
  500 FORMAT(4I6,F6.0,I6,5F3.2)
C IP=PLANTING DATE- IE=EMERGENCE DATE- IE=IP+8  FOR SORGHUM-NATRAC(IA)
C  FOR SORGHUM=191  DEGREE DAYS AFTER IE. MAXIMIN
C  ATTRACTION FOR SORGHUM BETWEEN BOOT AND MILK STAGE-1735 DEGREE DAYS
C  AFTER IE OR 1594 DEGREE DAYS AFTER NATRAC
C ASSUME 105,000 BOLLS/ACRE=1 BALE/ACRE
C DEGREE DAYS USED FOR HELIOTHIS ZEA IS ALSO USED FOR COTTON.
C IE TO IS(1ST SQ)=681.IS TO IB (1ST BOLL) 570.
C IB TO IM(1ST OPEN BOLL)=1130.
C NATRAC=DAY OF FIRST SQUARE
      IF(KCROP.EQ.3.AND.IP.EQ.0)IP=90
      IF(IP.EQ.0)IP=75
      IF(IE.EQ.0)IE=IP+8
      IF(NATRAC.NE.0)GO TO 60
      IA=IE+1
      IF(KCROP.EQ.3)GO TO 65
      IF(IF.NE.0) GO TO 63
   61 SUM=EDCORN(IA)-EDCORN(IE)
      IF(SUM.GE.DDA)GO TO 62
      IA=IA+1
      GO TO 61
```

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      65 SUM=ED(IA)-ED(IE)
         IF(SUM.GE.DDB)GO TO 62
         IA=IA+1
         GO TO 65
   63    IA=IF-50
         DDF=DD*.84
   67    IF(EDCORN(IF)-EDCORN(IA).GE.DDF)GO TO 62
         IA=IA-1
         GO TO 67
      62 NATRAC=IA
      60 KFF=IFIRST-1
         IA=NATRAC
         SEXRTO(KFF,1)=0.0
         SEXRTO(KFF,2)=0.0
         EGLYTM(KFF)=EGLYTM(IFIRST)
         DO 5 K=KFF,ILAST
C ADJUSTES PROBABLE EGG LAY FOR TEMPERATURE
         X=ABS(75.-EGLYTM(K))
         IF(X.GT.21.) X=21.
         IF(X.LT.3.) X=2.
         P=1.1-.05146*X
      9  DO 5 IN=IH,IV
         IF(K.GE.NATRAC)GO TO 110
         EGLYPR(K,IN)=.1*P
         EGLYCR(K,IN)=.333
         X=0.
         GO TO 111
  110 GO TO (102,105,103,108,5),KCROP
C NATRAC IS DATE CROP BECOMES ATTRACTIVE TO HELIOTHIS
C CORN-NATRAC WHEN 6-12 INCHES TALL-1210 DEGREE DAYS
C FROM NATRAC TO MAXIMUM SILKING-(50-86 DEGREES)
C NATRAC ALSO DATE WHEN SEARCH AREA=1 UNIT
  102 X=(EDCORN(K)-EDCORN(NATRAC))/DD
         IF(X.GT.1.60) GO TO 112
  120 IF(K.GT.ILASTC) GO TO 104
         IF(KODE(1).NE.3) GO TO 104
C REPLACE GO TO 104 WITH GO TO 106 IF TRAP SEX RATIO TO BE USED
         GO TO 104
  105 X=(EDCORN(K)-EDCORN(NATRAC))/DD
         IF(X.GT.1.2)GO TO 112
         IF(K.GT.ILASTC)GO TO 107
         IF(KODE(1).NE.3)GO TO 107
         GO TO 106
  103 X=(ED(K)-ED(NATRAC))/26
         IF(K.GT.ILASTC)GO TO 111
         IF(KODE(1).NE.3.AND.KODE(1).NE.5) GO TO 111
  106 EGLYCR(K,IN)=(SQRT(SEXRTO(K,IN)))/3.
         IF(EGLYCR(K,IN).GT.1)EGLYCR(K,IN)=1.0
         IF(EGLYCR(K,IN).LT..166) EGLYCR(K,IN)=.166
         EGLYPR(K,IN)=EGLYCR(K,IN)*P
         GO TO 111
C-SEXRTO EQUATIONS NEED TO BE PUT HERE OR CAL. OF EGGLAY PROOF-
  104 IF(IH.EQ.1.AND.IN.EQ.2)GO TO 2
         IF(X.GT.1.12) GO TO 2016
         IF(X.GT..86846)GO TO 2015
         SEXRTO(K,IN)=A30+(A31+(A32+A33*X)*X)*X
         GO TO 2019
 2016 SEXRTO(K,IN)=A40+(A41+A42*X)*X
         GO TO 2019
 2015 SEXRTO(K,IN)=A20+(A21+A22*X)*X
 2019 EGLYCR(K,IN)=SQRT(SEXRTO(K,IN))
         IF(EGLYCR(K,IN).LT..166) EGLYCR(K,IN)=.166
         EGLYPR(K,IN)=EGLYCR(K,IN)*P
         GO TO 111
  107 IF(IH.EQ.1.AND.IN.EQ.2)GO TO 2
         IF(X.GT..835)GO TO 2025
         SEXRTO(K,IN)=AM30+(AM31+(AM32+AM33*X)*X)*X
         GO TO 2026
 2025 SEXRTO(K,IN)=AM20+(AM21+AM22*X)*X
C REDUCTION OF EGG LAY DUE TO CROP FACTOR (.5 FOR SORGHUM)
 2026 EGLYCR(K,IN)=SQRT(SEXRTO(K,IN))*.5
         EGLYPR(K,IN)=EGLYCR(K,IN)*P
         GO TO 111
  112 EGLYPR(K,IN)=0.
         EGLYCR(K,IN)=.166
  111 GO TO (10,11,12,13),KCROP
   10 CONTINUE
         IF(IH.EQ.1.AND.IN.EQ.2) GO TO 2
         IF(X.LT..84) GO TO 303
         IF(X.GT.1.16) GO TO 303
         IM=K
         TP=(1.-X)*16.66667
         S=.4*EXP(-(TP*TP)/2.)
         DELTAX=(X-X1)/.06
C ASSUME 1 EAR PER PLANT
```

```
      302 EARS(K)=EARS(K-1)+PLANTS    *S*DELTAX
          GO TO 304
      303 EARS (K)=EARS(K-1)
      304 X1=X
          IF(K.LE.NATRAC)GO TO 300
          IF(X.GT.1)GO TO 301
          SAREA(K)=X*5.+1.
          GO TO 33
      300 SAREA(K)=1.0
          GO TO 33
      301 SAREA(K)=SAREA(K-1)
C ASSUME 6 SITES PER PLANT AT A SEARCH AREA OF 1
       33 SITES(K)=SAREA(K)*PLANTS    +EARS(K)
          IF(KODE(6).EQ.0)GO TO 5
          CALL MIGRAT
          GO TO 5
       11 CONTINUE
          IF(IH.EQ.1.AND.IN.EQ.2) GO TO 2
          IF(X.LT..84) GO TO 404
          IF(X.GT.1.16)GO TO 404
          IM=K
          TP=(1.-X)/.04
          S=.4*EXP(-(TP*TP)/2.)
          DELTAX=(X-X1)/.04
          HEADS(K)=HEADS(K-1)+PLANTS*S*DELTAX
          GO TO 405
      404 HEADS(K)=HEADS(K-1)
      405 X1=X
          IF(K.LE.NATRAC)GO TO 400
          IF(X.GT.1)GO TO 401
          SAREA(K)=X*5.+1
          GO TO 43
      400 SAREA(K)=1.0
          GO TO 43
      401 SAREA(K)=SAREA(K-1)
       43 SITES(K)=SAREA(K)*PLANTS+HEADS(K)
          IF(KODE(6).EQ.0)GO TO 5
          CALL MIGRAT
          GO TO 5
       12 CONTINUE
C   IS=FIRST SQUARE, IB = FIRST BOLL, IE=EMERGENCE DATE, IP=PLANTING DATE
          IM=NATRAC+88
          IF(IH.EQ.1.AND.IN.EQ.2)GO TO 2
           IF(K.LT.NATRAC)GO TO 21
          IF(X.GT.88.)GO TO 22
          IF(K.EQ.KFF)X1=X-1.
          TP=(40.-X)/13.3
          S=.4*EXP(-(TP*TP)/2.)
          DELTAX=(X-X1)/13.3
          SQUARE(K)=S*DELTAX*YIELDS
          GO TO 24
       22 SQUARE(K)=0.0
       24 IF(X.LE.21.)GO TO 23
          TP=(66.-X)/16.
          S=.4*EXP(-(TP*TP)/2.)
          DELTAX=(X-X1)/16.
          BOLLS(K)=S*DELTAX*YIELDB
          GO TO 26
       23 BOLLS(K)=0.0
       26 SAREA(K)=X/20.+1.0
          FRUIT=SQUARE(K)+BOLLS(K)
       27 SITES(K)=SAREA(K)*PLANTS+FRUIT
          X1=X
          IF(K.GT.ILASTC) GO TO 28
          IF(KODE(1).EQ.3.OR.KODE(1).EQ.5) GO TO 5
C REDUCTION OF EGG LAY DUE TO CROP FACTOT(.7 FOR COTTON)
       28 EGLYCR(K,IN)=(FRUIT/YIELDT+.1)*.7
          EGLYPR(K,IN)=EGLYCR(K,IN)*P
          GO TO 5
       21 SQUARE(K)=0.0
          BOLLS(K)=0.0
          SAREA(K)=1.0
          SITES(K)=PLANTS
          X1=X
          GO TO 5
        2 EGLYPR(K,IN)=EGLYPR(K,IN-1)
          EGLYCR(K,IN)=EGLYCR(K,IN-1)
          IF(KODE(6).NE.1)GO TO 5
          CALL MIGRAT
          GO TO 5
      108 EGLYCR(K,IN)=.5
          EGLYPR(K,IN)=.5*P
        5 CONTINUE
       13 RETURN
          END
```

```
      SUBROUTINE EGGINP
C   THIS SUBROUTINE HANDLES THE  INPUT OF HELIOTHIS POPULATIONS FOR
C   INITIATING THE MODEL.
      COMMON KCDE(20),FACTD,DJM1(4744),IFIRST,ILASTC,IH,IV,DUM2(1110),
     AILAST,KRUN,SEXRTO(370,2),EGPEMT(2),PCTCRP(5),DUM3(5290),ADTSMG
     B(370,2,2),TOTAL(370,9,2),SUBEGG(9692)
      DIMENSION EQELAD(370,2)
      DIMENSION S(10)
      IEND=370
      IF(KRUN.EQ.0) GO TO 20
      DO 21 I=1,370
      DO 21 J=IH,IV
      EQELAD(I,J)=0.
   21 TOTAL (I,7,J)=0.0
      IF(KODE(6).EQ.2) GO TO 22
20    CONTINUE
      L=KODE(1)
      X=1.
      IF(L.EQ.4)X=.31
      IF(L.EQ.6)X=.31
      GO TO (1,2,3,2,22,30,30),L
C READS IN MOTHES TOTAL NO. BOTH SEXES COMBINED
1     DO 19 J=IFIRST,ILASTC
11    READ(11,502)I,BMALE,BFMALE,CMALE,CFMALE
      IF(I.NE.J) GO TO 11
      TOTAL(I,7,1)=(BMALE+BFMALE)
      TOTAL(I,7,2)=(CMALE+CFMALE)
19    CONTINUE
      GO TO 5
C READS IN 0-1 DAY OLD EGGS/ACRE
2     DO 29 J=IFIRST,ILASTC
12    READ(11,501)I,B,C
  501 FORMAT(9X,I3,2F6.0)
      IF(I.NE.J) GO TO 12
      IF(L.EQ.4)I=I-2
      TOTAL(I,7,1)=(B/EGPEMT(1))*X
      TOTAL(I,7,2)=(C/EGPEMT(2))*X
29    CONTINUE
      GO TO 5
C READS IN MOTHES SEX SEPARATELY
3     DO 39 J=IFIRST,ILASTC
13    READ(11,502)I,BMALE,BFMALE,CMALE,CFMALE
  502 FORMAT(I6,4F6.1)
      IF(I.NE.J) GO TO 13
      TOTAL(I,7,1)=BMALE        *2.
      TOTAL(I,7,2)=CMALE        *2.
      SEXRTO(I,1)=(BMALE+1.0)/(BFMALE+1.)
      SEXRTO(I,2)=(CMALE+1.0)/(CFMALE+1.)
39    CONTINUE
      GO TO 5
30    ILASTC=1
      IFIRST=365
      READ(11,504)B,C,I
  504 FORMAT(18X,2F6.0,6X,I3)
      IF(I.EQ.0)GO TO 5
      IF(L.EQ.6)I=I-2
      TOTAL(I,7,1)=(B*X)/EGPEMT(1)
      TOTAL(I,7,2)=(C*X)/EGPEMT(2)
      IF(IFIRST.GT.I)IFIRST=I
      IL=ILASTC
      IF(ILASTC.LT.I)ILASTC=I
      IF(IFIRST.EQ.ILASTC)GO TO 31
      IDD=ILASTC-IL
      IF(IDD.EQ.1)GO TO 31
      XDL1=TOTAL(ILASTC,7,1)-TOTAL(IL,7,1)
      XDL2=TOTAL(ILASTC,7,2)-TOTAL(IL,7,2)
      XDL1=XDL1/IDD
      XDL2=XDL2/IDD
      IDD=IDD-1
      DO 32 J=1,IDD
      TOTAL(IL+J,7,1)=TOTAL(IL,7,1)+XDL1*J
      TOTAL(IL+J,7,2)=TOTAL(IL,7,2)+XDL2*J
   32 CONTINUE
      GO TO 30
   31 IL=ILASTC
      GO TO 30
   22 DO 24 I=IFIRST,ILAST
      DO 24 IN=IH,IV
      IF(IN.EQ.2) GO TO 27
      DO 28 J=1,2
C   MOTHS EMERGING FROM CORN LAY 3 TIMES AS MANY EGGS AS MOTHS EMERGING
C   FROM SORGHUM.
      XEGG=1.0
      IF(J.EQ.2)XEGG=.333
      TOTAL(I,7,IN)=(ADTSMG(I,J,IN)*PCTCRP(J)/PCTCRP(KODE(11)))*XEGG+TOT
```

```
      2AL(I,7,IN)
   28 CONTINUE
      GO TO 24
27    IF(I.GT.ILASTC) GO TO 24
26    READ(11,503)K,CMALE,CFMALE
503   FORMAT(I6,12X,2F6.1)
      IF(K.NE.I) GO TO 26
      TOTAL(I,7,IN)=CMALE*2.
   24 CONTINUE
5     CONTINUE
      RETURN
      END
```

```
      SUBROUTINE FLDPOP
C  THIS SUBROUTINE CONVERTS LIGHT TRAP CATCHES TO FIELD POPULATION(MOTHS
C  /ACRE)AS DESCRIBED BY HARTSTACK ET AL (1971) AND HARTSTACK AND
C  HOLLINGSWORTH (1974). THE LIGHT TRAP CATCHES ARE ADJUSTED FOR LOW
C  NIGHT TEMPERATURE ALSO.
      REAL NITMIN
      COMMON KODE(20),FACTD,DUM37(1480),NITMIN(370),DUM38(2524),EGLYTM(3
     A70),IFIRST,ILASTC,IH,IV,ADMOON(370),DUM39(9259),TOTAL(370,9,2),
     BDUM0(9267),IN,DUMP(3),IPX,SFLP(420)
      DATA E,R,FD/.428,98.8,10560./
C TRAP FACTORS FOR 40 WATT BLACKLIGHT TRAP.
      IF (KODE(3).EQ.2)RETURN
      C= 2.*3.1416*R**2.*E*(ALOG((FD+R)/R)-(FD/(FD+R)))
      FACTD=43560./C
C  NEW TRAP DESIGN REDUCES CATCH BY 30 PERCENT IF CENTER CYLINDER IS
C  NOT COUNTED.
      FACTD=FACTD*1.30
C ADJUSTMENT OF TRAP CATCH FOR REDUCTION OF CATCH BY LOW TEMPERATURES.
      IHH=IH
      IF(KODE(1).EQ.7) IHH=2
      DO 100 IDY=IFIRST,ILASTC
      DO 100 IN=IHH,IV
      IF(IDY.GE.154) GO TO 102
      F=136.9-.86667*IDY
      A1=312.4-5.8*IDY
      A2=-23.6753+.20281*IDY
      A3=.252667-.001762*IDY
      TEMP=NITMIN(IDY)
      IF(TEMP.LT.55.) TEMP=55.
      F1=A1+(A2+A3*TEMP)*TEMP
      TRAPIN=FACTD*F/F1
      IF(TRAPIN.LT.FACTD)TRAPIN=FACTD
      GO TO 103
102   TRAPIN=FACTD
103   TOTAL(IDY,7,IN)=(TOTAL(IDY,7,IN)*TRAPIN)
100   CONTINUE
      IF(KODE(8).EQ.0) RETURN
C  IF ACTUAL TRAP CATCHES ARE USED-SUBROUTINE SMOOTH IS CALLED AND
C  CATCHES ARE SMOOTHED BY A DOUBLE 3 DAY MOVING AVERAGE.
      DO 101 I=IHH,IV
      IPX=12
      IN=1
      IF(I.EQ.2)IN=10
      CALL SMOOTH
101   CONTINUE
      RETURN
      END
```

```
      SUBROUTINE GENLN
C  THIS SUBROUTINE CALCULATES THE NUMBER OF DAYS REQUIRED FOR
C  DEVELOPMENT OF VARIOUS INSECT STAGES ALONG WITH EXPECTED DEVIATIONS
C  FROM MEAN DEVELOPMENT TIME.
      COMMON KODE(20),DUM9,SDEV(370,4),DUM10(370),ED(370),DUM11(2524),
     QIFIRST,DUM12,IH,IV,DUM13(1110),ILAST,KRUN,DUM14(747),IGEN(370,14),
     WTEMAVG(370),SGENLN(18572)
      DIMENSION DEGDAY(6,2),A1(4),A2(4),A3(4)
      DIMENSION JS(4),P(6)
      DIMENSION F(4)
      DATA A1/3*9.35,6.41/,A2/3*-.2235,-.1555/,A3/3*.00135,.00095/
      DATA F/1.0,1.73,1.73,1.41/
      DATA IKODE/0/
    5 IF(KODE(11).EQ.IKODE) RETURN
C  REMOVE NEXT CARD (IF(KRUN.NE.0)RETURN) IF DEVELOPMENT TIME IS TO
C  BE CHANGED.
      IF(KRUN.NE.0) RETURN
      IF(KODE(11).EQ.2.AND.IKODE.EQ.1) RETURN
```

```
      IF(KODE(11).EQ.1.AND.IKODE.EQ.2) RETURN
      IKODE=KODE(11)
      GO TO (1,1,2,1),IKODE
    2 CONTINUE
    1 DEGDAY(1,1)=72.9
      DEGDAY(1,2)=69.
      DEGDAY(2,1)=156.8
      DEGDAY(2,2)=156.8
      DEGDAY(3,1)=216.5
      DEGDAY(3,2)=216.5
      DEGDAY(4,1)=323.1
      DEGDAY(4,2)=323.1
      DEGDAY(5,1)=1000.0
      DEGDAY(5,2)=1000.0
    3 CONTINUE
      IN=7*(IH-1)
      EDICK=ED(IFIRST-1)
      DO 100 I=IFIRST,ILAST
      IGENX=0
      DO 104 L=1,4
      J=L+IN
      SDEV(I,L)=0.0
      DO 101 K=I,365
      X=A1(L)+(A2(L)+A3(L)*TEMAVG(I))*TEMAVG(I)
      SDEV(I,L)=SDEV(I,L)+X*X
      IF(ED(K)-EDICK.LT.DEGDAY(L,IH)) GO TO 101
      IX=K-I+1
      IGENX=IGENX+IX
      IGEN(I,J)=IX
      SDEV(I,L)=SQRT(SDEV(I,L)/IX)*F(L)
      GO TO 104
  101 CONTINUE
  104 CONTINUE
      IGEN(I,IN+5)=(5327.35*TEMAVG(I)**(-1.8238))+.6
      IGEN(I,IN+7)=IGENX+IGEN(I,IN+5)
      IGEN(I,IN+6)=28.25-.24037*TEMAVG(I)
      EDICK=ED(I)
  100 CONTINUE
      IF(IH.EQ.2) RETURN
      IF(IV.EQ.1)RETURN
      DO 202 I=1,4
  202 P(I)=DEGDAY(I,2)/DEGDAY(I,1)
      DO 200 K=IFIRST,ILAST
      DO 203 I=1,4
      J=I+7
      IGEN(K,J)=IGEN(K,I)*P(I)+.5
203   CONTINUE
      DO 201 I=5,7
      J=I+7
      IGEN(K,J)=IGEN(K,I)
201   CONTINUE
  200 CONTINUE
      RETURN
      END
```

```
      SUBROUTINE GRAPH
C  THE USE OF THIS SUBROUTINE IS OPTIONAL DEPENDING ON THE NEED FOR A
C  GRAPH OF THE OUTPUT AND OR INPUT OF THE MODEL.
      COMMON KODE(20),DUM66(4001),S(4),DUM67(740),IFIRST,DUM68(1113),
     AILAST,DUM69(6298),EQELAD(370,2),DUM70(1480),TOTAL(370,9,2),DUM71
     B(9272),IGKODE(12,3),DATX(370),SGRAPH(14)
      DIMENSION SCALE(5)
      INTEGER VFA(5)/'(1H ',',I4,',',     ',',X,I1',')    '/
      INTEGER VF8(5)/'(1H+',',4X,',',     ',',X,I1',')    '/
      INTEGER DIGIT(127),DIGIT1(70),DIGIT2(57)
      EQUIVALENCE(DIGIT(1),DIGIT1(1)),(DIGIT(71),DIGIT2(1))
      DATA    DIGIT1    /'1','2','3','4','5','6','7','8','9','10','11','
     X12','13','14','15','16','17','18','19','20','21','22','23','24','2
     X5','26','27','28','29','30','31','32','33','34','35','36','37','38
     X','39','40','41','42','43','44','45','46','47','48','49','50','51'
     X,'52','53','54','55','56','57','58','59','60','61','62','63','64',
     X'65','66','67','68','69','70'/
      DATA    DIGIT2    /'71','72','73','74','75','76','77','78','79','8
     X0','81','82','83','84','85','86','87','88','89','90','91','92','93
     X','94','95','96','97','98','99','100','101','102','103','104','105
     X','106','107','108','109','110','111','112','113','114','115','116
     X','117','118','119','120','121','122','123','124','125','126','127
     X'/
      DIMENSION INSECT(3),ISTAGE(10)
      DATA INSECT/'-ZEA','-VIR','-Z+V'/
      DATA  ISTAGE/'EGGS','SLAR','LLAR','PUPA','POAD','OPAD','INPT','IN
     2MG','PAEG','EQOA'/
      DIMENSION SS(2)
```

```
      SXZ=0.
      SXV=0.
      SXZV=0.
      N=1
      WRITE(1,611)
  611 FORMAT('1')
      NSCALE=0
      ISTG=1
      KSTG=4
   24 DO 2020 IS=ISTG,KSTG
      DO 2020 IN=1,3
      IF(IGKODE(IS,IN).EQ.0)GO TO 2020
      IF(IN.EQ.1)SXZ=1
      IF(IN.EQ.2)SXV=1
      IF(IN.EQ.3)SXZV=1
      WRITE(1,610)N,ISTAGE(IS),INSECT(IN)
  610 FORMAT(' ',20X,I1,' = ',A4,A4)
      N=N+1
 2020 CONTINUE
      IF(IS.GT.6)GO TO 25
      ISTG=9
      KSTG=9
      GO TO 24
   25 CONTINUE
      NN=N
      IF(N.EQ.1)GO TO 2021
      IF(KODE(16).GE.100)GO TO 2024
      WRITE(1,600)
  600 FORMAT(' LOG SCALE PLOT')
      WRITE(1,604)
  604 FORMAT(' ',3X,'100.0',25X,'1000.0',25X,'10000.0',23X,'100000.0'
     V23X,'1000000.0')
      GO TO 2021
 2024 WRITE(1,603)
  603 FORMAT(' LINEAR SCALE PLOT')
   13 IF(SXZ.EQ.1.AND.SXV.EQ.1.AND.SXZV.NE.1)GO TO 10
      IF(SXZV.EQ.1)GO TO 11
      IF(SXZ.EQ.1)SX1=S(1+NSCALE)
      IF(SXV.EQ.1)SX1=S(2+NSCALE)
      GO TO 12
   10 SX1=S(1+NSCALE)
      IF(S(2+NSCALE).GT.S(1+NSCALE))SX1=S(2+NSCALE)
      GO TO 12
   11 SX1=S(1+NSCALE)+S(2+NSCALE)
   12 SCALE(1)=0.0
      DO 101 I=2,5
  101 SCALE(I)=SCALE(I-1)+SX1/4.
      WRITE(1,606)(SCALE(I),I=1,5)
  606 FORMAT(' ',F6.0,2(F31.0,F32.0))
      IF(NSCALE.EQ.0)SS(1)=SX1/127.
      IF(NSCALE.EQ.2)SS(2)=SX1/127.
      IF(NSCALE.EQ.2)GO TO 2023
 2021 ISTG=5
      KSTG=8
   27 DO 2022 IS=ISTG,KSTG
      DO 2022 IN=1,3
      IF(IGKODE(IS,IN).EQ.0) GO TO 2022
      IF(IN.EQ.1)SXZ=1
      IF(IN.EQ.2)SXV=1
      IF(IN.EQ.3)SXZV=1
      WRITE(1,610)N,ISTAGE(IS),INSECT(IN)
      N=N+1
 2022 CONTINUE
      IF(IS.GT.9)GO TO 26
      ISTG=10
      KSTG=10
      GO TO 27
   26 CONTINUE
      IF(N.EQ.NN)GO TO 2023
      IF(KODE(16).GE.100)GO TO 2025
      WRITE(1,600)
      WRITE(1,605)
  605 FORMAT(' ',5X,'1.0',27X,'10.0',27X,'100.0',25X,'1000.0',25X,
     N'10000.0')
      GO TO 2023
 2025 WRITE(1,603)
      NSCALE=2
      GO TO 13
 2023 IF(KODE(16).LT.100)GO TO 3000
      DO 3001 J=IFIRST,ILAST
      WRITE(1,601)J
  601 FORMAT(' ',I4,' .',30X,'.',31X,'.',30X,'.',31X,'.')
      N=1
      DO 3002 I=1,12
      DO 3002 IN=1,3
```

```
114           IF(IGKODE(I,IN).EQ.0)GO TO 3002
115           IF(IN.EQ.3)GO TO 3003
116           GO TO (4,4,4,4,5,5,5,5,4,6,3004,3005),I
117         5 K=TOTAL(J,I,IN)/SS(2)+1.
118           GO TO 302
119         4 K=TOTAL(J,I,IN)/SS(1)+1.
120           GO TO 302
121         6 K=EQELAD(J,IN)/SS(2)+1.
122           GO TO 302
123      3005 K=DATX(J)/SS(2)+1.
124           GO TO 302
125      3004 K=DATX(J)/SS(1)+1.
126           GO TO 302
127      3003 GO TO (7,7,7,7,8,8,8,8,7,9,3004,3005),I
128         7 K=(TOTAL(J,I,1)+TOTAL(J,I,2))/SS(1) +1.
129           GO TO 302
130         8 K=(TOTAL(J,I,1)+TOTAL(J,I,2))/SS(2) +1.
131           GO TO 302
132         9 K=(EQELAD(J,1)+EQELAD(J,2))/SS(2)+1.
133       302 IF(K.GT.127) K=127
134           VFB(3)=DIGIT(K)
135           WRITE(1,VFB)N
136           N=N+1
137      3002 CONTINUE
138      3001 CONTINUE
139           GO TO 5000
140      3000 DO 4000 J=IFIRST,ILAST
141           WRITE(1,601)J
142           N=1
143           DO 4002 I=1,10
144           DO 4002 IN=1,3
145           IF(IGKODE(I,IN).EQ.0)GO TO 4002
146           IF(IN.EQ.3) GO TO 4003
147           GO TO (14,14,14,14,15,15,15,15,14,16 ),I
148        14 B=TOTAL(J,I,IN)/100.
149           GO TO 207
150        15 B=TOTAL(J,I,IN)
151           GO TO 207
152        16 B=EQELAD(J,IN)
153           GO TO 207
154      4003 GO TO (17,17,17,17,18,18,18,18,17,19),I
155        17 B=(TOTAL(J,I,1)+TOTAL(J,I,2))/100.
156           GO TO 207
157        18 B=(TOTAL(J,I,1)+TOTAL(J,I,2))
158           GO TO 207
159        19 B=EQELAD(J,1)+EQELAD(J,2)
160       207 IF(B.LT.1.1)GO TO 203
161           K=(ALOG10(B)/4.)*127
162           IF(K.GT.127)K=127
163      205  VFB(3)=DIGIT(K)
164           WRITE(1,VFB)N
165           GO TO 208
166       203 K=1
167           GO TO 205
168       208 CONTINUE
169           N=N+1
170           GO TO 4002
171      4002 CONTINUE
172      4000 CONTINUE
173      5000 CONTINUE
174           RETURN
175           END
```

```
 1           SUBROUTINE MIGRAT
 2      C   THIS SUBROUTINE CALCULATES THE PROBABILITY OF MOTHS MIGRATING AWAY
 3      C   FROM A PARTICULAR CROP.
 4           COMMON KODE(20),DUM55(27698),PRMGRT(370,2),DUM56(747),KCROP,DUM57(
 5          A1119),IN,K,DUM58,X,SMIGRA(421)
 6           DIMENSION PCTMG(2)
 7           DATA PCTMG(1)/.6/,PCTMG(2)/.6/
 8           DATA XM/1.10/,XD/1.45/
 9           IF(KODE(15).EQ.0) RETURN
10           PRMGRT(K,IN)=0.0
11           IF(X.LE.XM)RETURN
12           IF(X.GE.XD)GO TO 1
13           PRMGRT(K,IN)=((X-XM)/(XD-XM))*PCTMG(IN)
14           RETURN
15         1 PRMGRT (K,IN)=PCTMG(IN)
16           RETURN
17           END
```

```
      SUBROUTINE MOON
C  FOR EACH SIMULATION DAY THIS SUBROUTINE CALCULATES THE NUMBER OF
C  DAYS FROM FULL MOON, WHICH IS USED TO SELECT THE PROPER MOONLIGHT
C  ADJUSTMENT FACTOR FOR OVIPOSTION.
      COMMON KODE(20),DUM31(4749),ADMOON(370),DUM32(370),TCLOUD(370),
     ZSMOON(24871)
      DIMENSION FM(29)
      DATA FM/1.,1.,.99,.99,.98,.97,.94,.91,.86,.82,.73,.61,.45,.24,.24,
     2.53,.75,.89,.96,10*1./
      A=KODE(3)
      IF(A.GT.15.) A=A-29.5
      A=A-15.
      DO100 I=1,365
      B=I
      J=B-A
      IF(J.LT.30)GOTO 4
      A=A+29.5
      J=1
 4    CONTINUE
      ADMOON(I)=FM(J)+(1.-FM(J))*TCLOUD(I)
 100  CONTINUE
      RETURN
      END
```

```
      SUBROUTINE PARINP
C  THIS SUBROUTINE CALCULATES PARASITISM OF EGGS AND LARVAE AS DESCRIBED
C  IN TEXT
      COMMON KODE(20),DUM21(4745),IFIRST,DUM22(373),SAREA(370),DUM23(370
     A),ILAST,KRUN,DUM24(20357),PARSIT(370,2),DUM25(1480),IA,IM,SPAR(229
     30)
      DIMENSION PA(2)
      IF(KRUN.EQ.0) GO TO 10
      DO 11 I=IFIRST,ILAST
      DO 11 J=1,2
   11 PARSIT(I,J)=0.0
   10 L=KODE(5)
C IF KODE 5 = 4 READ PA(1) = C
      GO TO (1,2,3,1),L
    1 PMIN1=IA
      PMAX1=IA+20
      PMIN2=IA+20
      PMAX2=IM-20
      PDOWN=IM
      PEND=IM+25
      READ(5,500) PA(1),PA(2)
  500 FORMAT(2F6.3)
      DO 4 I=IFIRST,ILAST
      IF(I.LE.PMIN1.OR.I.GE.PEND) GO TO 4
      IF(KODE(11).EQ.3) GO TO 44
      IF(I.GE.PMAX1) GO TO 7
      FX=((I-PMIN1)/(PMAX1-PMIN1))*.5
      GO TO 6
    7 IF(I.GT.PMIN2) GO TO 8
      FX=.5
      GO TO 6
    8 IF(I.GE.PMAX2) GO TO 9
      FX=.5+((I-PMIN2)/(PMAX2-PMIN2))*.5
      GO TO 6
    9 IF(I.GT.PDOWN) GO TO 99
   98 FX=1.0
      GO TO 6
   99 FX=(PEND-I)/(PEND-PDOWN)
      GO TO 6
   44 IF(I.GE.PMAX1) GO TO 45
      FX=(I-PMIN1)/(PMAX1-PMIN1)
      GO TO 6
   45 IF(I.GT.PMAX2) GO TO 46
      GO TO 98
   46 FX=(PEND-I)/(PEND-PMAX2)
    6 PARSIT(I,1)=PA(1)*FX
      PARSIT(I,2)=PA(2)*FX
    4 CONTINUE
      IF(L.EQ.4)GO TO 12
      GO TO 5
    2 READ(13,501,END=5)I,TRICH,OTHERS,OLARPA
  501 FORMAT(I6,3F6.0)
      IF(I.EQ.0) GO TO 5
C  EGG PARASITIZM
      N=45769
      B=-.693/(N*SAREA(I))
      PTRICH=1.-(EXP(TRICH*B))
      N=5000
      B=-.693/(N*SAREA(I))
      POTHRS=1.-(EXP(OTHERS*B))
```

```
      PARSIT(I,1)=1.-((1.-PTRICH)*(1.-POTHRS))
C  1-3 INSTAR LARVAE PARASITIZM
      N=300
      B=-.693/(N*SAREA(I))
      POTHRS=1.-(EXP(OLARPA*B))
      PARSIT(I,2)=POTHRS
      GO TO 2
    3 READ (13,502,END=5)I,X,Y
  502 FORMAT(I6,2F6.2)
      IF(I.EQ.0) GO TO 5
      PARSIT(I,1)=X
      PARSIT(I,2)=Y
      GO TO 3
   12 READ(13,501,END=5)I,TRICH
      IF(I.EQ.0)GO TO 5
      PARSIT(I,1)=TRICH
      GO TO 12
    5 RETURN
      END
```

```
      SUBROUTINE PRDINP
C  THIS SUBROUTINE CALCULATES PREDATION OF EGGS AND LARVAE AS DESCRIBED
C  IN TEXT.
      COMMON KODE(20),DUM26(4745),IFIRST,DUM27(373),SAREA(370),DUM28(370
     A),ILAST,KRUN,DUM29(21097),PREDOR(370,2),DUM30(740),IA,IM,SPRD(2290
     B)
      DIMENSION PA(2)
      DIMENSION PDERTE(7),PDLRTE(7),PRED(7)
      DATA PDERTE/1.25,1.5,.25,.5,1.0,.75,1.75/
      DATA PDLRTE/.5,1.0,.25,.75,1.25,1.75,1.50/
C PDLRTE=PREDATOR RATING FOR LARVAE
C PDERTE=PREDATOR RATING FOR EGGS
C 1=SEYMINUS,2=OTHER COCCINELLIDAE,3=OTHERCOLEOPTERA,
C 4= ORIUS,5=GEOCORIS,6=OTHER HEMIPTERA,7=CHRYSOPAIMMATURES
      IF(KRUN.EQ.0) GO TO 10
      DO 11 I=IFIRST,ILAST
      DO 11 J=1,2
   11 PREDOR(I,J)=0.0
   10 L=KODE(12)
      FX=1.0
      GO TO (1,2,3,30),L
    1 PMIN1=IA
      PMAX1=IA+20
      PMIN2=IA+20
      PMAX2=IM-20
      PDOWN=IM
      PEND=IM+25
      READ(5,500) PA(1),PA(2)
  500 FORMAT(3F6.3)
      DO 4 I=IFIRST,ILAST
      IF(I.LE.PMIN1.OR.I.GE.PEND) GO TO 4
      IF(KODE(11).EQ.3) GO TO 44
      IF(I.GE.PMAX1) GO TO 7
      FX=((I-PMIN1)/(PMAX1-PMIN1))*.5
      GO TO 6
    7 IF(I.GT.PMIN2) GO TO 8
      FX=.5
      GO TO 6
    8 IF(I.GE.PMAX2) GO TO 9
      FX=.5+((I-PMIN2)/(PMAX2-PMIN2))*.5
      GO TO 6
    9 IF(I.GT.PDOWN) GO TO 99
   98 FX=1.0
      GO TO 6
   99 FX=(PEND-I)/(PEND-PDOWN)
      GO TO 6
   44 IF(I.GE.PMAX1) GO TO 45
      FX=(I-PMIN1)/(PMAX1-PMIN1)
      GO TO 6
   45 IF(I.GT.PMAX2) GO TO 46
      GO TO 98
   46 FX=(PEND-I)/(PEND-PMAX2)
    6 PREDOR(I,1)=PA(1)*FX
      PREDOR(I,2)=PA(2)*FX
    4 CONTINUE
      GO TO 5
    2 READ(14,501,END=5)I,(PRED(J),J=1,7),SPID,CHRYSP
  501 FORMAT(9X,I3,6F6.0,6X,2F6.0,6X,F6.0)
      IF(I.EQ.0) GO TO 5
      OTHEGG=0.0
```

```
      OTHLAR=0.0
      DO 20 K=1,7
      OTHEGG=OTHEGG+PRED(K)*PDERTE(K)
      OTHLAR=OTHLAR+PRED(K)*PDLRTE(K)
   20 CONTINUE
C  EGG PREDATION
      N=44827
      B=-.693/(N*SAREA(I))
      PCHRYS=1.-(EXP(CHRYSP*B))
      N=14368
      B=-.693/(N*SAREA(I))
      POTHRS=1.-(EXP(OTHEGG*B))
      PREDOR(I,1)=1.-(1.-PCHRYS)*(1.-POTHRS)
C  1-3 INSTAR LARVAE PREDATION
      N=13051
      B=-.693/(N*SAREA(I))
      PCHRYS=1.-(EXP(CHRYSP*B))
      N=8929
      B=-.693/(N*SAREA(I))
      POTHRS =1.-(EXP(OTHLAR*B))
      PREDOR(I,2)=1.-(1.-PCHRYS)*(1.-POTHRS)
      GO TO 2
    3 READ(14,502,END=5) I,X,Y,Z
  502 FORMAT(I6,3F6.3)
      IF(I.EQ.0) GO TO 5
      PREDOR(I,1)=X
      PREDOR(I,2)=Y
      GO TO 3
   30 IFF=365
      ILL=1
   31 READ(14,503,END=34)SP,ALB,HEMP,CHL,CHA,CALLOP,I
  503 FORMAT(6X,6F5.0,I3)
      IF(I.EQ.0) GO TO 34
      PREDOR(I,1)=ALB*1.5+HEMP*1.0+CHL*1.75+CHA+CALLOP
      PREDOR(I,2)=ALB+HEMP*1.25+CHL*1.5+CHA+CALLOP
      IF(IFF.GT.I)IFF=I
      IL=ILL
      IF(ILL.LT.I)ILL=I
      IF(IFF.EQ.ILL)GO TO 32
      IDD=ILL-IL
      IF(IDD.EQ.1)GO TO 32
      XDL1=PREDOR(ILL,1)-PREDOR(IL,1)
      XDL2=PREDOR(ILL,2)-PREDOR(IL,2)
      XDL1=XDL1/ILD
      XDL2=XDL2/IDD
      IDD=IDD-1
      DO 33 J=1,IDD
      PREDOR(IL+J,1)=PREDOR(IL,1)+XDL1*J
      PREDOR(IL+J,2)=PREDOR(IL,2)+XDL2*J
   33 CONTINUE
      GO TO 31
   32 IL=ILL
      GO TO 31
   34 NF=14368
      NL=8929
      DO 35 J=IFF,ILL
      B=-.693/(NF*SAREA(J))
      PREDOR(J,1)=1.-(EXP(PREDOR(J,1)*B))
      B=-.693/(NL*SAREA(J))
      PREDOR(J,2)=1.-(EXP(PREDOR(J,2)*B))
   35 CONTINUE
    5 RETURN
      END
```

```
      SUBROUTINE SMOOTH
C  THIS SUBROUTINE WHEN CALLED APPLIES A DOUBLE 3-DAY MOVING AVERAGE
C  TO INSECT POPULATION DATA.
      COMMON DUM62(4765),IXF,IXL,DUM63(7411),SM(370,24),DUM64(9267),IN,
     ADUM65(3),IPX,SSMOO(420)
C IXF-FIRST DAY OF SMOOTH IXL-LAST DAY OF SMOOTH IP- STAGE IN- INSECT
      DIMENSION S(5)
      IP=IPX+IN
      DO 100 I=3,5
  100 S(I)=0.0
      IXXF=IXF+2
      S(1)=SM(IXF+1,IP)
      S(2)=SM(IXF,IP)
      DO 101 I=IXXF,IXL
      K=0
      DO 102 J=2,5
      S(5-K)=S(4-K)
```

```
      102 K=K+1
          S(1)=SM(I,IP)
          SM(I-2,IP)=(S(5)+2.*S(4)+3.*S(3)+2.*S(2)+S(1))/9.
      101 CONTINUE
          SM(IXL-1,IP)=(S(4)+2.*S(3)+3.*S(2)+2.*S(1))/8.
          SM(IXL,IP)=(S(3)+2.*S(2)+3.*S(1))/6.
          RETURN
          END
```

```
      SUBROUTINE SPRAY
C READS IN INSECTICIDE MORTALITIES-J-1THRU12
C  THIS SUBROUTINE HANDLES ALL INPUT OF MORTALITIES CAUSED BY
C  INSECTICIDES.
      COMMON KODE(20),DUM33(4745),IFIRST,DUM34,IH,IV,DUM35(1110),ILAST,
     AKRUN,DUM36(15177),POS(370,7,2),SSPRAY(4512)
      DIMENSION P(7,2)
      IF(KODE(4).EQ.2) RETURN
      IF(KODE(4).EQ.0.AND.KRUN.EQ.0)RETURN
      DO 2 J=1,7
      DO 2 I=IFIRST,ILAST
      DO 2 IN=IH,IV
    2 POS(I,J,IN)=0.0
      IF(KODE(4).EQ.0)RETURN
  100 READ(12,500,END=5)I,((P(J,IN),J=1,7),IN=IH,IV)
  500 FORMAT(I6,14F4.3)
      IF(I.EQ.0)RETURN
      DO 101 IN=IH,IV
      DO 101 J=1,7
  101 POS(I,J,IN)=P(J,IN)
      GO TO 100
    5 RETURN
      END
```

```
      SUBROUTINE TEMP
C  ALL OF THE TEMPERATURE AND CLOUD COVER INPUT AND THE CALCULATION OF
C  DAYS ARE HANDLED BY TEMP.
      REAL NITMIN
      COMMON KODE(20),DUM5(1481),NITMIN(370),ED(370),EDCORN(300),DUM6
     A(1854),EGLYTM(370),IFIRST,DUM7(743),TCLOUD(370),ILAST,DUM8(5928),
     BTEMAVG(370),STEMP(18572),IFISTT,ILASTT
      DIMENSION CLOUD(24)
      DIMENSION TMEA(800)
      DIMENSION TM(24)
      KKK=KODE(2)
      KK=KODE(19)
      ED(IFISTT-1)=0.0
      EDCORN(IFISTT-1)=0.0
      ET=54.7
      T1=50.
      T2=86.
      TD=T2-T1
  503 FORMAT(I3,2F3.0)
      DO 404 IDY=IFISTT,ILASTT
      IF(KKK.NE.3) GO TO 200
      IF(IDY.EQ.IFISTT) GO TO 404
      GO TO 410
  800 KRUN=2
  200 READ(15,502,END=402) I,(TM(J),J=1,24)
  502 FORMAT(2X,I3,3X,24F3.0)
      IF(I.NE.IDY) GO TO 200
      M=I
      GO TO 499
  402 CONTINUE
      WRITE(6,1000) IFISTT,M
 1000 FORMAT('1','HOUPLY TEMPERATURE INPUT FROM DAYS ',I3,' TO ',I3)
  404 READ(16,503) I,THP,TLP
      IF(I.NE.IDY) GO TO 404
      WRITE(6,2000) IDY,ILASTT
 2000 FORMAT(' ','MAX/MIN TEMPERATURE INPUT FROM DAYS ',I3,' TO ',I3/)
      KKK=3
  410 CONTINUE
      THO=THP
      TLO=TLP
      READ(16,503) I,THP,TLP
      TAO=(THO+TLO)/2.
      TPO=(THO-TLO)/2.
      TAM=(THO+TLP)/2.
      TPM=(THO-TLP)/2.
      TM(1)=TAO+TPO*(-.96593)
      DO 417 J=2,14
```

```
48            TM(J)=TAO+TPO*COS(.2618*(14-J))
49      417   CONTINUE
50            DO 419 J=15,24
51            TM(J)=TAM+TPM*COS(.2618*(J-14))
52      419   CONTINUE
53      499   IF(KK.EQ.0) GO TO 305
54      201   READ(17,504,END=306) I,(CLOUD(J),J=1,24)
55      504   FORMAT(2X,I3,3X,24F3.1)
56            IF(I.NE.IDY) GO TO 201
57            GO TO 305
58      306   CONTINUE
59            KK=0
60        305 CONTINUE
61        213 ED(IDY)=ED(IDY-1)
62            EDCORN(IDY)=EDCORN(IDY-1)
63            TEMAVG(IDY)=0.0
64            NITMIN(IDY)=0.0
65            DO 3 I=1,24
66            IF (TM(I).GT.92) GO TO 565
67            TEM=(TM(I)-ET)/24.
68            IF (TEM.LT.0.) TEM=0.
69            GO TO 35
70        565 TEMOVR=TM(I)-92.
71            TEM=(37.3-TEMOVR)/24.
72         35 CONTINUE
73            X=TM(I)-T1
74            IF(X)39,39,32
75         32 IF(X-TD)34,34,33
76         33 X=TD-1.423*(X-TD)
77         34 EDCORN(IDY)=EDCORN(IDY)+X/24.
78         39 CONTINUE
79            IF(I.GT.6)GO TO 563
80            NITMIN(IDY-1)=NITMIN(IDY-1)+TM(I)/12.
81            GO TO 561
82        563 IF(I.LT.19)GO TO 561
83            NITMIN(IDY)=NITMIN(IDY)+TM(I)/12.
84        561 ED(IDY)=ED(IDY)+TEM
85        562 TEMAVG(IDY)=TEMAVG(IDY)+TM(I)/24.
86          3 CONTINUE
87            DAYLN=12.14+1.94*COS(.01721*(IDY-175))
88            IEGG=13.5+DAYLN/2.
89            EGLYTM(IDY)=(TM(IEGG)+TM(IEGG+1)+TM(IEGG+2))/3.
90            IF(KK.EQ.0) GO TO 304
91            TCLOUD(IDY)=(CLOUD(IEGG)+CLOUD(IEGG+1)+CLOUD(IEGG+2))/3.
92        304 CONTINUE
93        200 RETURN
94            END
```

```
 1            SUBROUTINE TRKGRM
 2      C  THIS SUBROUTINE PROVIDES A DYNAMIC POPULATION MODEL
 3      C  FOR TRICHOGRAMMA.
 4            COMMON KODE(20),DUM40(5119),SAREA(370),DUM41(370),ILAST,DUM42(748)
 5           A,IGEN(370,7,2),DUM43(2590),TOTAL(370,9,2),POS(370,7,2),PARSIT(370,
 6           B2),PREDOP(370,2),DUM45(743),I,DUM46(1863),IN,DUM47(410),TP,DEATH(5
 7           C,2),STPK(3)
 8            DIMENSION FERATE(20)
 9            DATA TKSUBV/1./
10            DATA FERATE/.5,..8,..87,..95,..95,..95,..93,..9,..82,..74,..68,..6,..55,..5,..45
11           2,..4,..3,..2,..1,0./
12            IF(TP.LT.1)RETURN
13            TOTAL(I,9,IN)= TOTAL(I,9,IN)+TP
14            TS=TP
15            K=I+IGEN(I,1,IN)+IGEN(I,2,IN)-1
16            IF(K.GT.ILAST)RETURN
17            II=I+1
18            DO 100 J=II,K
19            X=PREDOP(J,1)*(1.-POS(J,2,IN))
20            X=(1.-X)*(1.-DEATH(1,IN))*(1.-POS(J,7,IN))
21            TS=TS*X
22            TOTAL(J,9,IN)=TOTAL(J,9,IN)+TS
23            TOTAL(J,1,IN)=TOTAL(J,1,IN)+TS
24        100 CONTINUE
25            IF(KODE(5).NE.4) RETURN
26      C ASSUME EGGS ARE HARD TO FIND AS FUNCTION OF SAREA
27      C ASSUME 2 FEMALES EMERGE FROM EACH EGG.
28            TS=TS*2.*SAREA(II)
29            K=K+1
30            KK=K+10
31            IF(KK.GT.ILAST)KK=ILAST
32            IAGE=1
```

```
      DO 200 J=K,KK
      TS=TS*TKSURV
      PARSIT(J,1)=TS*FERATE(IAGE)+PARSIT(J,1)
      IAGE=IAGE+1
  200 CONTINUE
      RETURN
      END
```

```
      FUNCTION DISTR(DISTS)
C  THIS SUBROUTINE CALCULATES THE DEVELOPMENT DISTRIBUTIONS OF COHERTS
C  OF EGGS, LARVAE, AND PUPA. A NORMAL DISTRIBUTION IS ASSUMED (STINNER
C  1974). THE ARRAY GAUS IS AN ACCUMULATION OF THE NORMAL DISTRIBUTION
C  PROBABILITIES FOR + OR - 4 STANDARD DEVIATIONS FROM THE MEAN.
      COMMON DUM72(30328),X,DUM73(418),XBAR,XSD,DUM74
      DIMENSION GAUS1(40),GAUS2(40),GAUS(81)
      EQUIVALENCE (GAUS1(1),GAUS(2)),(GAUS2(1),GAUS(42))
      DATA GAUS(1)/.00003/
      DATA GAUS1/.00005,.00007,.0001,.00015,.00020,.0003,.0005,.0007,.00
     110,.0013,.0019,.0026,.0035,.0047,.0062,.0082,.0107,.0139,.0179,.02
     228,.0287,.0359,.0446,.0548,.0668,.0808,.0968,.1151,.1357,.1587,.18
     341,.2119,.2420,.2743,.3085,.3446,.3821,.4207,.4602,.5000/
      DATA GAUS2/.5388,.5793,.6179,.6554,.6915,.7257,.7580,.7881,.8159,.
     28413,.8643,.8849,.9032,.9192,.9332,.9452,.9554,.9641,.9713,.9772,.
     39821,.9861,.9893,.9918,.9938,.9953,.9965,.9974,.9981,.9987,.9990,.
     49993,.9995,.9997,.9998,.99985,.9999,.99993,.99995,.99997/
      Y=(X-XBAR+.5)/XSD
      IF(Y.GT.-4.)GO TO 1
      DISTR=0.
      RETURN
    1 CONTINUE
      IF(Y.LT.4.)GO TO 2
      DISTR=1.-DISTS
      DISTS=1.
      RETURN
    2 CONTINUE
      INDEX=IFIX((Y+4.1)*10.)
      Y=GAUS(INDEX)
      DISTR=Y-DISTS
      DISTS=Y
      RETURN
      END
```

# EXAMPLE INPUT

```
  3   1  27   0   1   1 160   1   1 205   1   1   1   1   1 102   1   3
 45  40  40  30 150 900 300  45  40  40  30 150 900 400
 82 146
 59 236
   56    71   140       14000         2 18 18 59  1
  060   010
  150   200
1 1 1
              1 1   1
```

```
   82    10                                                ALL CROPS LT 1975
   83                                                      ALL CROPS LT 1975
   84    02                                                ALL CROPS LT 1975
   85                                                      ALL CROPS LT 1975
   86    08    02                                          ALL CROPS LT 1975
   87                                                      ALL CROPS LT 1975
   88                                                      ALL CROPS LT 1975
   89    02                                                ALL CROPS LT 1975
   90    02    04                                          ALL CROPS LT 1975
   91    12    02                                          ALL CROPS LT 1975
   92    02                                                ALL CROPS LT 1975
   93                                                      ALL CROPS LT 1975
   94          01                                          ALL CROPS LT 1975
   95    02                                                ALL CROPS LT 1975
   96    08    06                                          ALL CROPS LT 1975
   97    10    07                                          ALL CROPS LT 1975
   98    81    37                                          ALL CROPS LT 1975
   99    09    10                                          ALL CROPS LT 1975
  100    01    04                                          ALL CROPS LT 1975
  101          02                                          ALL CROPS LT 1975
  102    01                                                ALL CROPS LT 1975
  103                                                      ALL CROPS LT 1975
```

| | | | | | |
|---|---|---|---|---|---|
| 34 | 104 | 38 | 24 | | ALL CROPS LT 1975 |
| 35 | 105 | 02 | 06 | | ALL CROPS LT 1975 |
| 36 | 106 | 11 | 03 | | ALL CROPS LT 1975 |
| 37 | 107 | | 5 | | CORN LT 1975 ACTU |
| 38 | 108 | | | | CORN LT 1975 ACTU |
| 39 | 109 | | | | CORN LT 1975 ACTU |
| 40 | 110 | 10 | | | CORN LT 1975 ACTU |
| 41 | 111 | 25 | | | CORN LT 1975 ACTU |
| 42 | 112 | 15 | | | CORN LT 1975 ACTU |
| 43 | 113 | 10 | | | CORN LT 1975 ACTU |
| 44 | 114 | 05 | | | CORN LT 1975 ACTU |
| 45 | 115 | 20 | | | CORN LT 1975 ACTU |
| 46 | 116 | 00 | 08 | | CORN LT 1975 ACTU |
| 47 | 117 | 48 | 13 | | CORN LT 1975 ACTU |
| 48 | 118 | 25 | 00 | | CORN LT 1975 ACTU |
| 49 | 119 | 23 | 28 | | CORN LT 1975 ACTU |
| 50 | 120 | 10 | 00 | | CORN LT 1975 ACTU |
| 51 | 121 | 55 | 20 | | CORN LT 1975 ACTU |
| 52 | 122 | 105 | 25 | | CORN LT 1975 ACTU |
| 53 | 123 | 95 | 43 | | CORN LT 1975 ACTU |
| 54 | 124 | 60 | 18 | | CORN LT 1975 ACTU |
| 55 | 125 | 108 | 15 | | CORN LT 1975 ACTU |
| 56 | 126 | 190 | 50 | | CORN LT 1975 ACTU |
| 57 | 127 | 17 | 07 | | CORN LT 1975 ACTU |
| 58 | 128 | 03 | 03 | | CORN LT 1975 ACTU |
| 59 | 129 | 50 | 18 | | CORN LT 1975 ACTU |
| 60 | 130 | 05 | 28 | | CORN LT 1975 ACTU |
| 61 | 131 | 20 | 03 | | CORN LT 1975 ACTU |
| 62 | 132 | | | | CORN LT 1975 ACTU |
| 63 | 133 | 03 | 05 | | CORN LT 1975 ACTU |
| 64 | 134 | 03 | | | CORN LT 1975 ACTU |
| 65 | 135 | 03 | 05 | | CORN LT 1975 ACTU |
| 66 | 136 | 05 | | | CORN LT 1975 ACTU |
| 67 | 137 | 05 | 03 | | CORN LT 1975 ACTU |
| 68 | 138 | 23 | 20 | | CORN LT 1975 ACTU |
| 69 | 139 | 28 | 33 | | CORN LT 1975 ACTU |
| 70 | 140 | 33 | 10 | | CORN LT 1975 ACTU |
| 71 | 141 | 30 | 20 | | CORN LT 1975 ACTU |
| 72 | 142 | 38 | 28 | | CORN LT 1975 ACTU |
| 73 | 143 | 130 | 78 | | CORN LT 1975 ACTU |
| 74 | 144 | 65 | 23 | | CORN LT 1975 ACTU |
| 75 | 145 | 65 | 15 | | CORN LT 1975 ACTU |
| 76 | 146 | 30 | 35 | | CORN LT 1975 ACTU |
| 77 | | | | | |
| 78 | | | | | |

| | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 79 | 1 | 59 | 75 | 56 | 54 | 53 | 52 | 51 | 48 | 48 | 53 | 58 | 60 | 62 | 66 | 65 | 67 | 72 | 74 | 73 | 71 | 66 | 64 | 61 |
| 80 | 1 | 60 | 75 | 56 | 54 | 54 | 57 | 58 | 61 | 62 | 63 | 65 | 68 | 72 | 74 | 76 | 79 | 78 | 80 | 79 | 74 | 67 | 63 | 63 |
| 81 | 1 | 61 | 75 | 59 | 56 | 56 | 54 | 52 | 51 | 47 | 52 | 57 | 61 | 65 | 67 | 69 | 71 | 73 | 73 | 71 | 68 | 63 | 61 | 59 |
| 82 | 1 | 62 | 75 | 58 | 57 | 56 | 56 | 55 | 55 | 54 | 54 | 54 | 54 | 54 | 57 | 57 | 59 | 59 | 58 | 57 | 54 | 50 | 49 | 46 |
| 83 | 1 | 63 | 75 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 41 | 43 | 43 | 45 | 46 | 46 | 47 | 47 | 46 | 42 | 43 | 43 |
| 84 | 1 | 64 | 75 | 41 | 41 | 40 | 40 | 40 | 41 | 41 | 42 | 43 | 43 | 43 | 44 | 49 | 51 | 54 | 54 | 55 | 54 | 53 | 53 | 53 |
| 85 | 1 | 65 | 75 | 53 | 54 | 54 | 54 | 55 | 57 | 58 | 59 | 62 | 65 | 67 | 69 | 70 | 77 | 77 | 78 | 77 | 75 | 72 | 70 | 68 |
| 86 | 1 | 66 | 75 | 69 | 69 | 69 | 69 | 67 | 67 | 67 | 68 | 72 | 75 | 78 | 77 | 80 | 74 | 72 | 70 | 67 | 63 | 59 | 56 | 54 |
| 87 | 1 | 67 | 75 | 47 | 46 | 45 | 43 | 42 | 41 | 41 | 45 | 49 | 53 | 56 | 59 | 61 | 63 | 63 | 64 | 64 | 61 | 57 | 57 | 56 |
| 88 | 1 | 68 | 75 | 55 | 55 | 53 | 51 | 50 | 50 | 50 | 50 | 52 | 53 | 53 | 56 | 56 | 58 | 62 | 65 | 71 | 71 | 70 | 69 | 68 |
| 89 | 1 | 69 | 75 | 64 | 62 | 62 | 62 | 62 | 54 | 50 | 51 | 53 | 58 | 60 | 63 | 63 | 64 | 63 | 61 | 60 | 58 | 57 | 57 | 56 |
| 90 | 1 | 70 | 75 | 53 | 54 | 55 | 55 | 55 | 57 | 58 | 56 | 59 | 61 | 61 | 57 | 65 | 67 | 77 | 78 | 76 | 74 | 72 | 71 | 70 |
| 91 | 1 | 71 | 75 | 72 | 72 | 72 | 71 | 71 | 70 | 70 | 70 | 70 | 73 | 78 | 81 | 77 | 71 | 66 | 61 | 58 | 55 | 54 | 52 | 52 |
| 92 | 1 | 72 | 75 | 42 | 41 | 42 | 40 | 39 | 39 | 39 | 38 | 38 | 38 | 40 | 42 | 44 | 47 | 44 | 46 | 44 | 44 | 40 | 39 | 37 |
| 93 | 1 | 73 | 75 | 32 | 30 | 29 | 30 | 31 | 30 | 30 | 35 | 40 | 43 | 48 | 51 | 52 | 55 | 57 | 58 | 59 | 57 | 53 | 51 | 50 |
| 94 | 1 | 74 | 75 | 45 | 47 | 46 | 44 | 44 | 45 | 46 | 48 | 50 | 54 | 57 | 60 | 61 | 61 | 60 | 61 | 60 | 60 | 57 | 57 | 58 |
| 95 | 1 | 75 | 75 | 60 | 60 | 58 | 57 | 56 | 55 | 55 | 57 | 59 | 63 | 64 | 64 | 66 | 67 | 66 | 64 | 63 | 61 | 59 | 56 | 55 |
| 96 | 1 | 76 | 75 | 51 | 51 | 51 | 50 | 49 | 50 | 50 | 52 | 55 | 60 | 61 | 64 | 65 | 61 | 59 | 58 | 58 | 58 | 57 | 58 | 58 |
| 97 | 1 | 77 | 75 | 55 | 55 | 53 | 54 | 57 | 57 | 54 | 58 | 62 | 66 | 59 | 70 | 72 | 72 | 72 | 71 | 70 | 67 | 63 | 58 | 57 |
| 98 | 1 | 78 | 75 | 47 | 45 | 44 | 43 | 42 | 42 | 43 | 53 | 59 | 64 | 69 | 75 | 77 | 78 | 79 | 78 | 77 | 73 | 67 | 63 | 61 |
| 99 | 1 | 79 | 75 | 53 | 54 | 54 | 53 | 50 | 49 | 49 | 56 | 62 | 71 | 72 | 74 | 77 | 79 | 79 | 78 | 77 | 75 | 70 | 68 | 67 |
| 100 | 1 | 80 | 75 | 61 | 63 | 63 | 62 | 62 | 62 | 63 | 63 | 65 | 67 | 70 | 70 | 72 | 74 | 76 | 76 | 74 | 73 | 71 | 70 | 70 |
| 101 | 1 | 81 | 75 | 69 | 69 | 69 | 69 | 69 | 69 | 70 | 72 | 74 | 75 | 78 | 81 | 82 | 81 | 81 | 78 | 77 | 75 | 73 | 72 | |
| 102 | 1 | 82 | 75 | 70 | 70 | 70 | 71 | 72 | 72 | 70 | 70 | 71 | 71 | 73 | 73 | 74 | 75 | 75 | 75 | 75 | 72 | 72 | 67 | 65 |
| 103 | 1 | 83 | 75 | 56 | 54 | 52 | 51 | 50 | 50 | 50 | 56 | 61 | 64 | 65 | 68 | 70 | 73 | 73 | 71 | 70 | 67 | 63 | 59 | 54 |
| 104 | 1 | 84 | 75 | 51 | 50 | 51 | 47 | 46 | 47 | 46 | 54 | 64 | 71 | 74 | 77 | 78 | 80 | 80 | 79 | 77 | 74 | 69 | 65 | 63 |
| 105 | 1 | 85 | 75 | 55 | 52 | 53 | 52 | 52 | 53 | 57 | 59 | 61 | 63 | 65 | 66 | 68 | 70 | 68 | 68 | 67 | 66 | 67 | 70 | 71 |
| 106 | 1 | 86 | 75 | 70 | 70 | 70 | 70 | 70 | 70 | 70 | 70 | 71 | 73 | 74 | 77 | 81 | 83 | 84 | 82 | 81 | 78 | 75 | 73 | 73 |
| 107 | 1 | 87 | 75 | 71 | 71 | 71 | 71 | 71 | 71 | 72 | 72 | 72 | 73 | 73 | 60 | 56 | 52 | 49 | 46 | 45 | 44 | 44 | 45 | 45 |
| 108 | 1 | 88 | 75 | 45 | 45 | 44 | 42 | 46 | 39 | 40 | 40 | 40 | 40 | 41 | 42 | 43 | 42 | 40 | 39 | 38 | 39 | 39 | 38 | 37 |
| 109 | 1 | 89 | 75 | 35 | 35 | 35 | 35 | 34 | 33 | 34 | 38 | 42 | 46 | 49 | 52 | 55 | 55 | 56 | 57 | 57 | 55 | 53 | 43 | 44 |
| 110 | 1 | 90 | 75 | 43 | 41 | 41 | 43 | 41 | 45 | 46 | 50 | 52 | 52 | 54 | 53 | 54 | 56 | 59 | 60 | 60 | 57 | 53 | 50 | 49 |
| 111 | 1 | 91 | 75 | 48 | 46 | 46 | 48 | 47 | 47 | 48 | 50 | 52 | 57 | 63 | 66 | 70 | 73 | 74 | 75 | 74 | 69 | 65 | 62 | 61 |
| 112 | 1 | 92 | 75 | 62 | 62 | 63 | 64 | 64 | 65 | 66 | 67 | 68 | 56 | 59 | 62 | 67 | 61 | 62 | 61 | 59 | 57 | 53 | 50 | 48 |
| 113 | 1 | 93 | 75 | 41 | 41 | 39 | 39 | 37 | 34 | 36 | 41 | 46 | 50 | 53 | 53 | 59 | 61 | 62 | 64 | 62 | 60 | 56 | 51 | 49 |
| 114 | 1 | 94 | 75 | 46 | 45 | 44 | 43 | 43 | 43 | 43 | 47 | 53 | 55 | 59 | 61 | 63 | 64 | 65 | 65 | 64 | 61 | 59 | 57 | 56 |
| 115 | 1 | 95 | 75 | 53 | 52 | 51 | 51 | 50 | 50 | 53 | 57 | 61 | 62 | 65 | 67 | 67 | 67 | 68 | 70 | 65 | 64 | 62 | 61 | 60 |
| 116 | 1 | 96 | 75 | 60 | 60 | 61 | 61 | 60 | 60 | 60 | 61 | 63 | 65 | 70 | 71 | 75 | 75 | 76 | 74 | 73 | 70 | 68 | 67 | 65 |
| 117 | 1 | 97 | 75 | 60 | 59 | 58 | 57 | 57 | 58 | 59 | 61 | 63 | 66 | 67 | 68 | 72 | 70 | 69 | 69 | 69 | 68 | 66 | 66 | 67 |
| 118 | 1 | 98 | 75 | 70 | 65 | 63 | 62 | 63 | 61 | 59 | 59 | 60 | 62 | 64 | 64 | 66 | 67 | 66 | 65 | 64 | 64 | 64 | 63 | 63 |

| | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 119 | 1 | 99 | 75 | 62 | 62 | 62 | 63 | 62 | 62 | 62 | 65 | 69 | 72 | 76 | 77 | 77 | 79 | 80 | 79 | 77 | 74 | 71 | 70 | 68 |
| 120 | 1 | 100 | 75 | 66 | 66 | 67 | 63 | 64 | 62 | 62 | 64 | 65 | 72 | 72 | 71 | 73 | 76 | 70 | 67 | 66 | 66 | 65 | 63 | 62 |
| 121 | 1 | 101 | 75 | 55 | 55 | 54 | 53 | 52 | 51 | 53 | 59 | 61 | 66 | 68 | 69 | 70 | 70 | 71 | 73 | 70 | 67 | 63 | 61 | 59 |
| 122 | 1 | 102 | 75 | 55 | 54 | 52 | 51 | 49 | 50 | 51 | 54 | 59 | 60 | 63 | 65 | 66 | 68 | 69 | 70 | 67 | 65 | 62 | 61 | 60 |
| 123 | 1 | 103 | 75 | 57 | 57 | 55 | 55 | 56 | 56 | 55 | 56 | 59 | 61 | 64 | 65 | 62 | 62 | 61 | 62 | 61 | 59 | 56 | 56 | 55 |
| 124 | 1 | 104 | 75 | 55 | 55 | 54 | 54 | 53 | 53 | 53 | 54 | 55 | 55 | 57 | 59 | 62 | 63 | 66 | 67 | 68 | 65 | 59 | 57 | 56 |
| 125 | 1 | 105 | 75 | 47 | 47 | 46 | 46 | 46 | 46 | 47 | 51 | 55 | 57 | 58 | 62 | 67 | 69 | 72 | 73 | 73 | 72 | 66 | 62 | 61 |
| 126 | 1 | 106 | 75 | 54 | 53 | 51 | 51 | 50 | 50 | 52 | 58 | 64 | 60 | 72 | 74 | 76 | 78 | 78 | 77 | 77 | 74 | 70 | 68 | 66 |
| 127 | 1 | 107 | 75 | 64 | 65 | 66 | 66 | 66 | 67 | 67 | 68 | 70 | 71 | 72 | 72 | 78 | 80 | 80 | 79 | 78 | 76 | 75 | 75 | 74 |
| 128 | 1 | 108 | 75 | 73 | 73 | 72 | 72 | 72 | 72 | 72 | 74 | 77 | 79 | 80 | 81 | 81 | 83 | 84 | 85 | 80 | 78 | 76 | 75 | 72 |
| 129 | 1 | 109 | 75 | 61 | 59 | 60 | 60 | 60 | 55 | 55 | 59 | 62 | 64 | 67 | 70 | 73 | 73 | 75 | 75 | 74 | 72 | 67 | 64 | 62 |
| 130 | 1 | 110 | 75 | 60 | 60 | 59 | 57 | 57 | 56 | 57 | 59 | 62 | 67 | 72 | 74 | 74 | 75 | 76 | 75 | 72 | 70 | 67 | 64 | 63 |
| 131 | 1 | 111 | 75 | 61 | 60 | 59 | 60 | 60 | 60 | 60 | 60 | 61 | 62 | 63 | 65 | 68 | 69 | 70 | 68 | 66 | 65 | 63 | 63 | 62 |
| 132 | 1 | 112 | 75 | 61 | 62 | 62 | 62 | 63 | 64 | 64 | 65 | 67 | 68 | 70 | 76 | 79 | 79 | 81 | 81 | 80 | 78 | 75 | 73 | 71 |
| 133 | 1 | 113 | 75 | 70 | 70 | 69 | 70 | 69 | 69 | 69 | 70 | 73 | 76 | 77 | 78 | 78 | 80 | 81 | 80 | 79 | 77 | 75 | 74 | 73 |
| 134 | 1 | 114 | 75 | 72 | 72 | 72 | 71 | 70 | 70 | 71 | 72 | 75 | 79 | 82 | 83 | 85 | 85 | 86 | 85 | 82 | 80 | 78 | 75 | 74 |
| 135 | 1 | 115 | 75 | 72 | 72 | 72 | 71 | 71 | 71 | 72 | 74 | 76 | 79 | 81 | 82 | 83 | 84 | 85 | 85 | 83 | 81 | 79 | 76 | 75 |
| 136 | 1 | 116 | 75 | 74 | 74 | 74 | 74 | 73 | 73 | 73 | 76 | 77 | 80 | 81 | 81 | 82 | 83 | 85 | 84 | 82 | 79 | 78 | 76 | 76 |
| 137 | 1 | 117 | 75 | 74 | 73 | 73 | 72 | 71 | 71 | 72 | 74 | 76 | 79 | 81 | 85 | 83 | 84 | 84 | 85 | 82 | 80 | 77 | 76 | 75 |
| 138 | 1 | 118 | 75 | 73 | 73 | 73 | 73 | 72 | 72 | 72 | 63 | 64 | 64 | 66 | 66 | 68 | 69 | 68 | 68 | 67 | 68 | 66 | 68 | 69 |
| 139 | 1 | 119 | 75 | 67 | 67 | 67 | 68 | 68 | 67 | 70 | 73 | 75 | 79 | 81 | 82 | 83 | 84 | 84 | 81 | 79 | 76 | 68 | 69 | 69 |
| 140 | 1 | 120 | 75 | 63 | 63 | 63 | 65 | 66 | 68 | 69 | 70 | 70 | 68 | 65 | 70 | 67 | 73 | 79 | 79 | 80 | 78 | 75 | 71 | 69 |
| 141 | 1 | 121 | 75 | 67 | 66 | 65 | 64 | 61 | 61 | 64 | 68 | 71 | 73 | 76 | 76 | 79 | 81 | 81 | 79 | 78 | 78 | 77 | 74 | 73 |
| 142 | 1 | 122 | 75 | 69 | 69 | 68 | 69 | 69 | 68 | 69 | 70 | 72 | 74 | 77 | 79 | 79 | 79 | 80 | 80 | 79 | 78 | 76 | 75 | 75 |
| 143 | 1 | 123 | 75 | 72 | 72 | 72 | 73 | 73 | 73 | 74 | 75 | 78 | 78 | 79 | 80 | 80 | 78 | 81 | 82 | 80 | 80 | 77 | 74 | 73 |
| 144 | 1 | 124 | 75 | 73 | 69 | 68 | 67 | 67 | 67 | 68 | 71 | 74 | 75 | 76 | 81 | 81 | 84 | 80 | 84 | 84 | 80 | 69 | 68 | 64 |
| 145 | 1 | 125 | 75 | 66 | 66 | 64 | 64 | 64 | 65 | 66 | 69 | 72 | 75 | 79 | 81 | 78 | 78 | 77 | 76 | 76 | 77 | 75 | 74 | 73 |
| 146 | 1 | 126 | 75 | 71 | 73 | 71 | 73 | 73 | 73 | 73 | 77 | 77 | 78 | 81 | 83 | 82 | 84 | 83 | 82 | 81 | 79 | 79 | 77 | 77 |
| 147 | 1 | 127 | 75 | 73 | 73 | 73 | 73 | 73 | 74 | 75 | 74 | 77 | 79 | 82 | 84 | 85 | 86 | 88 | 85 | 83 | 72 | 74 | 65 | 65 |
| 148 | 1 | 128 | 75 | 65 | 65 | 65 | 65 | 65 | 65 | 66 | 68 | 69 | 71 | 78 | 79 | 83 | 84 | 83 | 82 | 80 | 78 | 77 | 62 | 64 |
| 149 | 1 | 129 | 75 | 66 | 63 | 62 | 62 | 60 | 61 | 65 | 70 | 73 | 74 | 77 | 80 | 81 | 83 | 84 | 84 | 82 | 81 | 78 | 76 | 76 |
| 150 | 1 | 130 | 75 | 71 | 72 | 69 | 68 | 67 | 67 | 67 | 67 | 67 | 70 | 71 | 75 | 77 | 79 | 81 | 79 | 81 | 79 | 76 | 75 | 73 |
| 151 | 1 | 131 | 75 | 70 | 70 | 70 | 70 | 69 | 69 | 70 | 71 | 73 | 75 | 79 | 80 | 79 | 68 | 65 | 67 | 67 | 68 | 66 | 64 | 65 |
| 152 | 1 | 132 | 75 | 64 | 64 | 65 | 64 | 62 | 61 | 64 | 69 | 72 | 76 | 78 | 79 | 81 | 81 | 82 | 82 | 82 | 81 | 77 | 74 | 73 |
| 153 | 1 | 133 | 75 | 68 | 69 | 67 | 66 | 65 | 66 | 67 | 70 | 73 | 75 | 77 | 80 | 80 | 80 | 81 | 83 | 82 | 79 | 75 | 75 | 73 |
| 154 | 1 | 134 | 75 | 62 | 62 | 62 | 61 | 60 | 61 | 62 | 66 | 69 | 71 | 73 | 75 | 76 | 78 | 75 | 75 | 74 | 74 | 69 | 66 | 64 |
| 155 | 1 | 135 | 75 | 62 | 62 | 61 | 61 | 61 | 62 | 63 | 66 | 69 | 68 | 69 | 69 | 74 | 73 | 72 | 73 | 75 | 72 | 70 | 67 | 65 |
| 156 | 1 | 136 | 75 | 64 | 64 | 63 | 63 | 63 | 63 | 64 | 69 | 72 | 75 | 77 | 79 | 80 | 82 | 80 | 81 | 81 | 79 | 71 | 69 | 68 |
| 157 | 1 | 137 | 75 | 60 | 60 | 61 | 61 | 59 | 58 | 64 | 70 | 74 | 77 | 79 | 80 | 77 | 81 | 82 | 82 | 81 | 80 | 76 | 73 | 68 |
| 158 | 1 | 138 | 75 | 65 | 64 | 64 | 64 | 64 | 64 | 67 | 72 | 76 | 79 | 82 | 83 | 85 | 83 | 85 | 85 | 82 | 82 | 79 | 77 | 75 |
| 159 | 1 | 139 | 75 | 67 | 66 | 66 | 65 | 65 | 65 | 68 | 73 | 76 | 79 | 82 | 82 | 83 | 85 | 85 | 84 | 82 | 80 | 79 | 78 | 77 |
| 160 | 1 | 140 | 75 | 74 | 74 | 74 | 74 | 74 | 73 | 75 | 76 | 79 | 79 | 84 | 85 | 85 | 87 | 83 | 84 | 83 | 80 | 80 | 78 | |
| 161 | 1 | 141 | 75 | 75 | 75 | 75 | 75 | 75 | 76 | 76 | 78 | 80 | 81 | 84 | 87 | 86 | 86 | 86 | 85 | 84 | 83 | 81 | 79 | 77 |
| 162 | 1 | 142 | 75 | 74 | 74 | 74 | 73 | 73 | 73 | 74 | 77 | 80 | 81 | 85 | 86 | 87 | 87 | 88 | 87 | 85 | 83 | 80 | 78 | 75 |
| 163 | 1 | 143 | 75 | 70 | 70 | 70 | 70 | 70 | 70 | 73 | 75 | 77 | 80 | 80 | 79 | 72 | 75 | 76 | 76 | 76 | 74 | 74 | 74 | 73 |
| 164 | 1 | 144 | 75 | 70 | 69 | 68 | 69 | 68 | 72 | 70 | 70 | 73 | 76 | 78 | 81 | 79 | 65 | 64 | 64 | 64 | 64 | 64 | 64 | 64 |
| 165 | 1 | 145 | 75 | 61 | 61 | 61 | 61 | 62 | 62 | 65 | 69 | 75 | 76 | 78 | 79 | 82 | 82 | 85 | 84 | 83 | 84 | 81 | 78 | 75 |
| 166 | 1 | 146 | 75 | 69 | 70 | 71 | 72 | 72 | 72 | 73 | 75 | 79 | 83 | 83 | 86 | 86 | 87 | 88 | 89 | 88 | 83 | 77 | 74 | 73 |
| 167 | 1 | 147 | 75 | 71 | 72 | 70 | 70 | 70 | 70 | 71 | 73 | 76 | 80 | 81 | 83 | 84 | 87 | 86 | 87 | 86 | 82 | 78 | 75 | 73 |
| 168 | 1 | 148 | 75 | 70 | 69 | 68 | 68 | 67 | 67 | 70 | 73 | 75 | 79 | 79 | 78 | 69 | 73 | 74 | 74 | 75 | 73 | 72 | 72 | 70 |
| 169 | 1 | 149 | 75 | 68 | 69 | 70 | 70 | 70 | 71 | 73 | 77 | 77 | 65 | 64 | 71 | 75 | 75 | 80 | 76 | 74 | 76 | 75 | 72 | 72 |
| 170 | 1 | 150 | 75 | 70 | 67 | 67 | 65 | 65 | 68 | 69 | 70 | 75 | 77 | 75 | 71 | 68 | 67 | 68 | 69 | 68 | 67 | 67 | 66 | 66 |
| 171 | 1 | 151 | 75 | 60 | 60 | 60 | 59 | 59 | 59 | 63 | 67 | 70 | 73 | 74 | 76 | 77 | 78 | 79 | 79 | 79 | 78 | 74 | 69 | 66 |
| 172 | 1 | 152 | 75 | 59 | 59 | 59 | 58 | 58 | 60 | 64 | 70 | 74 | 76 | 78 | 80 | 80 | 80 | 82 | 82 | 81 | 80 | 77 | 72 | 70 |
| 173 | 1 | 153 | 75 | 65 | 64 | 65 | 62 | 61 | 62 | 69 | 73 | 77 | 79 | 82 | 83 | 82 | 85 | 85 | 85 | 84 | 85 | 79 | 75 | 73 |
| 174 | 1 | 154 | 75 | 68 | 67 | 65 | 65 | 65 | 63 | 69 | 72 | 76 | 79 | 81 | 82 | 85 | 86 | 87 | 86 | 85 | 84 | 80 | 75 | 74 |
| 175 | 1 | 155 | 75 | 71 | 71 | 72 | 73 | 73 | 74 | 75 | 78 | 82 | 84 | 87 | 89 | 82 | 88 | 89 | 89 | 87 | 85 | 82 | 79 | 77 |
| 176 | 1 | 156 | 75 | 74 | 75 | 75 | 74 | 75 | 76 | 77 | 79 | 83 | 85 | 86 | 89 | 88 | 87 | 90 | 88 | 88 | 86 | 83 | 80 | 80 |
| 177 | 1 | 157 | 75 | 75 | 74 | 74 | 75 | 75 | 75 | 76 | 79 | 79 | 84 | 86 | 88 | 88 | 90 | 89 | 90 | 91 | 88 | 83 | 81 | 80 |
| 178 | 1 | 158 | 75 | 74 | 73 | 73 | 74 | 75 | 75 | 77 | 78 | 81 | 83 | 85 | 87 | 88 | 88 | 90 | 90 | 88 | 88 | 85 | 82 | 81 |
| 179 | 1 | 159 | 75 | 76 | 75 | 75 | 75 | 74 | 74 | 77 | 78 | 80 | 84 | 85 | 87 | 88 | 88 | 86 | 83 | 82 | 80 | 79 | 78 | 77 |
| 180 | 1 | 160 | 75 | 77 | 76 | 76 | 76 | 76 | 77 | 77 | 76 | 81 | 82 | 81 | 81 | 85 | 85 | 85 | 86 | 85 | 82 | 71 | 73 | 71 |
| 181 | 1 | 161 | 75 | 69 | 69 | 68 | 68 | 68 | 68 | 70 | 72 | 75 | 75 | 76 | 76 | 75 | 77 | 80 | 80 | 80 | 79 | 79 | 74 | 73 |
| 182 | 1 | 162 | 75 | 70 | 70 | 70 | 68 | 69 | 71 | 73 | 75 | 77 | 81 | 81 | 81 | 83 | 84 | 84 | 83 | 82 | 80 | 77 | 75 | 72 |
| 183 | 1 | 163 | 75 | 68 | 67 | 67 | 67 | 66 | 68 | 71 | 74 | 77 | 79 | 82 | 83 | 84 | 86 | 86 | 86 | 86 | 85 | 83 | 79 | 76 |
| 184 | 1 | 164 | 75 | 71 | 72 | 71 | 71 | 70 | 71 | 75 | 79 | 82 | 85 | 86 | 88 | 89 | 89 | 91 | 90 | 89 | 87 | 83 | 79 | 78 |
| 185 | 1 | 165 | 75 | 75 | 75 | 74 | 74 | 75 | 74 | 76 | 80 | 82 | 84 | 87 | 88 | 89 | 90 | 90 | 91 | 90 | 87 | 84 | 82 | 81 |
| 186 | 1 | 166 | 75 | 77 | 77 | 77 | 77 | 76 | 75 | 77 | 77 | 77 | 80 | 84 | 85 | 86 | 87 | 88 | 89 | 86 | 85 | 83 | 82 | 81 |
| 187 | 1 | 167 | 75 | 77 | 77 | 76 | 79 | 74 | 75 | 77 | 79 | 83 | 86 | 87 | 90 | 91 | 92 | 90 | 90 | 87 | 86 | 84 | 81 | 80 |
| 188 | 1 | 168 | 75 | 76 | 76 | 77 | 77 | 77 | 77 | 78 | 81 | 82 | 86 | 90 | 90 | 92 | 92 | 92 | 89 | 90 | 87 | 85 | 82 | 80 |
| 189 | 1 | 169 | 75 | 79 | 79 | 79 | 78 | 78 | 78 | 79 | 80 | 84 | 86 | 90 | 90 | 91 | 91 | 92 | 91 | 90 | 88 | 85 | 83 | 81 |
| 190 | 1 | 170 | 75 | 79 | 79 | 79 | 79 | 77 | 76 | 77 | 82 | 82 | 87 | 90 | 91 | 91 | 90 | 87 | 91 | 91 | 88 | 85 | 83 | 81 |
| 191 | 1 | 171 | 75 | 77 | 76 | 77 | 76 | 75 | 75 | 78 | 81 | 83 | 88 | 88 | 90 | 90 | 91 | 83 | 85 | 87 | 85 | 85 | 81 | 80 |
| 192 | 1 | 172 | 75 | 77 | 76 | 76 | 76 | 75 | 76 | 76 | 80 | 79 | 82 | 85 | 84 | 86 | 91 | 92 | 89 | 88 | 83 | 83 | 80 | 78 |
| 193 | 1 | 173 | 75 | 76 | 74 | 72 | 71 | 70 | 71 | 74 | 80 | 83 | 85 | 87 | 90 | 91 | 92 | 93 | 90 | 90 | 89 | 86 | 82 | 80 |
| 194 | 1 | 174 | 75 | 75 | 74 | 73 | 73 | 72 | 72 | 74 | 80 | 81 | 84 | 86 | 88 | 88 | 90 | 90 | 91 | 90 | 88 | 86 | 83 | 81 |
| 195 | 1 | 175 | 75 | 74 | 73 | 72 | 72 | 71 | 71 | 72 | 74 | 78 | 81 | 84 | 86 | 90 | 89 | 90 | 90 | 88 | 79 | 79 | 75 | 75 |
| 196 | 1 | 176 | 75 | 74 | 75 | 75 | 74 | 74 | 74 | 76 | 76 | 73 | 73 | 76 | 80 | 81 | 86 | 74 | 72 | 73 | 73 | 74 | 73 | 73 |
| 197 | 1 | 177 | 75 | 74 | 74 | 73 | 73 | 73 | 73 | 74 | 77 | 81 | 83 | 83 | 76 | 79 | 82 | 82 | 75 | 74 | 72 | 72 | 72 | 71 |
| 198 | 1 | 178 | 75 | 72 | 72 | 72 | 73 | 73 | 73 | 73 | 73 | 74 | 75 | 79 | 72 | 72 | 72 | 70 | 70 | 70 | 71 | 71 | 71 | 70 |
| 199 | 1 | 179 | 75 | 68 | 68 | 68 | 69 | 69 | 69 | 71 | 77 | 79 | 80 | 85 | 87 | 88 | 90 | 90 | 87 | 83 | 73 | 74 | 73 | 73 |
| 200 | 1 | 180 | 75 | 72 | 71 | 70 | 69 | 70 | 68 | 74 | 77 | 81 | 85 | 85 | 87 | 89 | 38 | 87 | 90 | 89 | 89 | 83 | 80 | 76 |
| 201 | 1 | 181 | 75 | 72 | 72 | 72 | 73 | 73 | 73 | 74 | 75 | 76 | 78 | 82 | 85 | 86 | 88 | 89 | 88 | 86 | 87 | 86 | 80 | 72 |
| 202 | 1 | 182 | 75 | 70 | 69 | 69 | 69 | 69 | 70 | 70 | 72 | 73 | 74 | 74 | 80 | 83 | 83 | 85 | 84 | 73 | 74 | 73 | 72 | 71 |
| 203 | 1 | 183 | 75 | 72 | 71 | 71 | 71 | 71 | 71 | 72 | 74 | 78 | 79 | 81 | 82 | 84 | 84 | 81 | 79 | 81 | 82 | 81 | 78 | 78 |

```
204     1 184  75  73  72  73  72  72  71  75  79  81  84  85  87  88  89  90  89  89  87  81  79  76
205     1 185  75  74  74  72  73  72  72  76  80  83  85  88  87  87  90  91  80  78  82  80  78  77
206     1 186  75  73  74  73  72  72  73  76  79  82  85  87  87  88  88  90  89  88  88  86  83  79
207     1 187  75  74  74  73  72  72  71  74  78  83  85  87  89  90  91  91  92  89  87  85  80  78
208     1 188  75  75  75  74  73  74  74  76  79  82  84  87  88  90  90  91  91  89  88  86  82  80
209     1 189  75  75  75  75  74  74  74  75  78  81  85  86  89  90  91  91  92  91  90  86  81  80
210     1 190  75  78  78  77  76  75  75  77  80  83  85  87  90  92  93  93  92  92  90  86  82  81
211     1 191  75  78  78  77  76  75  74  76  77  82  83  83  83  86  86  88  88  78  74  73  74  74
212     1 192  75  74  74  74  74  74  74  73  73  74  78  81  85  86  86  88  88  88  87  84  80  79
213     1 193  75  74  72  72  73  73  73  75  79  83  85  85  85  84  80  82  76  78  77  76  74  71
214     1 194  75  70  70  69  69  69  69  70  75  80  82  85  87  86  86  88  88  87  84  82  79  77
215     1 195  75  69  69  69  69  69  68  72  76  80  80  82  84  86  88  88  80  74  74  73  72  71
216     1 196  75  70  69  69  69  70  70  71  74  77  80  83  84  86  87  83  79  80  80  78  76  75
217     1 197  75  72  71  70  71  70  70  71  75  77  80  83  85  85  83  85  85  84  83  82  79  77
218     1 198  75  74  73  72  71  70  71  74  78  82  85  86  87  88  88  89  88  77  75  76  76  76
219     1 199  75  75  74  73  72  72  72  75  79  81  81  85  87  88  88  82  86  85  84  84  81  80
220     1 200  75  75  75  75  75  74  74  76  80  81  84  85  88  89  88  89  80  86  87  81  82  80
221     1 201  75  75  76  74  73  72  72  75  78  82  85  86  86  90  91  91  89  87  85  85  82  81
222       59  75   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
```

# EXAMPLE OUTPUT

```
HOURLY TEMPERATURE INPUT FROM DAYS  59 TO 201
MAX/MIN TEMPERATURE INPUT FROM DAYS 202 TO 236

INPUT FOR THE MODEL HAS BEEN HELIOTHIS ZEA ONLY
INPUT READ FROM   82 TO  146
  FACTOR= 0.585  RUN NO.=   0ZEA EGGFRT= 0.900VIRS EGGFRT= 0.900
ZEA EGGS/MOTH =  300. VIRS EGGS/MOTH=******PLANTS/ACRE=14000.

CROP PHENOLOGY: IE= 71,IA= 80,IF=140,IM=155
```

| DAY NO. | EGGPAR | 1-3PAR | EGGPRD | 1-3PRD | TCLOUD | NITMIN | TEMAVG | ADMOON | EGLYT™ | SQUARES | BOLLS | EARS | HEADS | SAREA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 82 | 0.003 | 0.000 | 0.007 | 0.010 | 0.0 | 58.8 | 70.5 | 0.730 | 68.0 | 0. | 0. | 0. | 0. | 1.2 |
| 83 | 0.004 | 0.001 | 0.011 | 0.015 | 0.0 | 51.7 | 59.5 | 0.610 | 58.7 | 0. | 0. | 0. | 0. | 1.2 |
| 84 | 0.006 | 0.001 | 0.015 | 0.020 | 0.0 | 57.0 | 63.1 | 0.450 | 65.7 | 0. | 0. | 0. | 0. | 1.3 |
| 85 | 0.007 | 0.001 | 0.019 | 0.025 | 0.0 | 70.1 | 63.2 | 0.240 | 69.3 | 0. | 0. | 0. | 0. | 1.3 |
| 86 | 0.009 | 0.001 | 0.022 | 0.030 | 0.0 | 71.8 | 74.2 | 0.240 | 73.7 | 0. | 0. | 0. | 0. | 1.4 |
| 87 | 0.010 | 0.002 | 0.026 | 0.035 | 0.0 | 44.2 | 58.7 | 0.530 | 44.7 | 0. | 0. | 0. | 0. | 1.5 |
| 88 | 0.012 | 0.002 | 0.030 | 0.040 | 0.0 | 35.7 | 40.3 | 0.750 | 38.0 | 0. | 0. | 0. | 0. | 1.5 |
| 89 | 0.013 | 0.002 | 0.034 | 0.045 | 0.0 | 43.8 | 44.8 | 0.890 | 46.7 | 0. | 0. | 0. | 0. | 1.5 |
| 90 | 0.015 | 0.002 | 0.037 | 0.050 | 0.0 | 48.3 | 50.2 | 0.960 | 50.7 | 0. | 0. | 0. | 0. | 1.5 |
| 91 | 0.016 | 0.003 | 0.041 | 0.055 | 0.0 | 62.2 | 59.1 | 1.000 | 62.7 | 0. | 0. | 0. | 0. | 1.5 |
| 92 | 0.018 | 0.003 | 0.045 | 0.060 | 0.0 | 42.7 | 58.6 | 1.000 | 50.3 | 0. | 0. | 0. | 0. | 1.6 |
| 93 | 0.019 | 0.003 | 0.049 | 0.065 | 0.0 | 46.7 | 48.9 | 1.000 | 52.0 | 0. | 0. | 0. | 0. | 1.6 |
| 94 | 0.021 | 0.003 | 0.052 | 0.070 | 0.0 | 53.5 | 54.1 | 1.000 | 57.3 | 0. | 0. | 0. | 0. | 1.6 |
| 95 | 0.022 | 0.004 | 0.056 | 0.075 | 0.0 | 60.4 | 59.8 | 1.000 | 61.0 | 0. | 0. | 0. | 0. | 1.6 |
| 96 | 0.024 | 0.004 | 0.060 | 0.080 | 0.0 | 61.2 | 65.9 | 1.000 | 66.7 | 0. | 0. | 0. | 0. | 1.7 |
| 97 | 0.025 | 0.004 | 0.064 | 0.085 | 0.0 | 65.3 | 64.6 | 1.000 | 66.3 | 0. | 0. | 0. | 0. | 1.8 |
| 98 | 0.027 | 0.004 | 0.067 | 0.090 | 0.0 | 62.4 | 63.3 | 1.000 | 63.3 | 0. | 0. | 0. | 0. | 1.8 |
| 99 | 0.028 | 0.005 | 0.071 | 0.095 | 0.0 | 66.0 | 69.3 | 1.000 | 69.7 | 0. | 0. | 0. | 0. | 1.9 |
| 100 | 0.030 | 0.005 | 0.075 | 0.100 | 0.0 | 57.2 | 65.7 | 1.000 | 63.3 | 0. | 0. | 0. | 0. | 2.0 |
| 101 | 0.031 | 0.005 | 0.077 | 0.103 | 0.0 | 55.2 | 61.2 | 1.000 | 61.0 | 0. | 0. | 0. | 0. | 2.0 |
| 102 | 0.032 | 0.005 | 0.079 | 0.106 | 0.0 | 57.4 | 59.2 | 1.000 | 61.0 | 0. | 0. | 0. | 0. | 2.0 |
| 103 | 0.033 | 0.005 | 0.081 | 0.109 | 0.0 | 54.7 | 58.1 | 1.000 | 55.7 | 0. | 0. | 0. | 0. | 2.1 |
| 104 | 0.033 | 0.006 | 0.084 | 0.111 | 0.0 | 50.2 | 57.2 | 0.990 | 57.3 | 0. | 0. | 0. | 0. | 2.1 |
| 105 | 0.034 | 0.006 | 0.086 | 0.114 | 0.0 | 56.0 | 58.2 | 0.990 | 63.0 | 0. | 0. | 0. | 0. | 2.1 |
| 106 | 0.035 | 0.006 | 0.088 | 0.117 | 0.0 | 65.9 | 64.4 | 0.980 | 68.0 | 0. | 0. | 0. | 0. | 2.2 |
| 107 | 0.036 | 0.006 | 0.090 | 0.120 | 0.0 | 73.1 | 72.0 | 0.970 | 74.7 | 0. | 0. | 0. | 0. | 2.3 |
| 108 | 0.037 | 0.006 | 0.092 | 0.123 | 0.0 | 65.0 | 75.5 | 0.940 | 74.3 | 0. | 0. | 0. | 0. | 2.4 |
| 109 | 0.038 | 0.006 | 0.094 | 0.126 | 0.0 | 60.7 | 64.7 | 0.910 | 64.3 | 0. | 0. | 0. | 0. | 2.4 |
| 110 | 0.039 | 0.006 | 0.096 | 0.129 | 0.0 | 61.7 | 65.1 | 0.860 | 64.7 | 0. | 0. | 0. | 0. | 2.5 |
| 111 | 0.039 | 0.007 | 0.099 | 0.131 | 0.0 | 62.1 | 62.8 | 0.820 | 62.0 | 0. | 0. | 0. | 0. | 2.6 |
| 112 | 0.040 | 0.007 | 0.101 | 0.134 | 0.0 | 70.7 | 70.5 | 0.730 | 71.7 | 0. | 0. | 0. | 0. | 2.6 |
| 113 | 0.041 | 0.007 | 0.103 | 0.137 | 0.0 | 71.9 | 73.8 | 0.610 | 73.0 | 0. | 0. | 0. | 0. | 2.7 |
| 114 | 0.042 | 0.007 | 0.105 | 0.140 | 0.0 | 72.9 | 76.6 | 0.450 | 74.0 | 0. | 0. | 0. | 0. | 2.8 |
| 115 | 0.043 | 0.007 | 0.107 | 0.143 | 0.0 | 74.5 | 76.9 | 0.240 | 75.0 | 0. | 0. | 0. | 0. | 3.0 |
| 116 | 0.044 | 0.007 | 0.109 | 0.146 | 0.0 | 74.2 | 77.5 | 0.240 | 76.0 | 0. | 0. | 0. | 0. | 3.1 |
| 117 | 0.045 | 0.007 | 0.111 | 0.149 | 0.0 | 73.9 | 77.1 | 0.530 | 75.3 | 0. | 0. | 0. | 0. | 3.2 |
| 118 | 0.045 | 0.008 | 0.114 | 0.151 | 0.0 | 67.4 | 68.5 | 0.750 | 68.3 | 0. | 0. | 0. | 0. | 3.2 |
| 119 | 0.046 | 0.008 | 0.116 | 0.154 | 0.0 | 65.5 | 72.9 | 0.890 | 67.3 | 0. | 0. | 0. | 0. | 3.3 |
| 120 | 0.047 | 0.008 | 0.118 | 0.157 | 0.0 | 66.9 | 69.8 | 0.960 | 69.3 | 0. | 0. | 0. | 0. | 3.4 |
| 121 | 0.048 | 0.008 | 0.120 | 0.160 | 0.0 | 70.8 | 71.9 | 1.000 | 73.3 | 0. | 0. | 0. | 0. | 3.5 |
| 122 | 0.049 | 0.008 | 0.122 | 0.163 | 0.0 | 73.3 | 73.9 | 1.000 | 74.7 | 0. | 0. | 0. | 0. | 3.6 |
| 123 | 0.050 | 0.008 | 0.124 | 0.166 | 0.0 | 70.8 | 75.8 | 1.000 | 72.7 | 0. | 0. | 0. | 0. | 3.7 |
| 124 | 0.051 | 0.008 | 0.126 | 0.169 | 0.0 | 65.1 | 72.5 | 1.000 | 65.0 | 0. | 0. | 0. | 0. | 3.8 |
| 125 | 0.051 | 0.009 | 0.129 | 0.171 | 0.0 | 72.9 | 72.2 | 1.000 | 73.3 | 0. | 0. | 0. | 0. | 3.9 |
| 126 | 0.052 | 0.009 | 0.131 | 0.174 | 0.0 | 74.8 | 77.2 | 1.000 | 76.7 | 0. | 0. | 0. | 0. | 4.0 |
| 127 | 0.053 | 0.009 | 0.133 | 0.177 | 0.0 | 65.7 | 75.3 | 1.000 | 65.0 | 0. | 0. | 0. | 0. | 4.1 |
| 128 | 0.054 | 0.009 | 0.135 | 0.180 | 0.0 | 64.7 | 71.4 | 1.000 | 64.0 | 0. | 0. | 0. | 0. | 4.2 |
| 129 | 0.055 | 0.009 | 0.137 | 0.183 | 0.0 | 71.8 | 73.2 | 1.000 | 75.0 | 0. | 0. | 0. | 0. | 4.3 |
| 130 | 0.056 | 0.009 | 0.139 | 0.186 | 0.0 | 71.4 | 72.7 | 1.000 | 73.3 | 0. | 0. | 0. | 0. | 4.4 |
| 131 | 0.057 | 0.009 | 0.141 | 0.189 | 0.0 | 63.9 | 69.5 | 1.000 | 64.3 | 0. | 0. | 0. | 0. | 4.5 |
| 132 | 0.057 | 0.010 | 0.144 | 0.191 | 0.0 | 69.5 | 72.5 | 1.000 | 72.7 | 0. | 0. | 0. | 0. | 4.5 |
| 133 | 0.058 | 0.010 | 0.146 | 0.194 | 0.0 | 66.4 | 73.2 | 0.990 | 73.3 | 0. | 0. | 0. | 0. | 4.6 |
| 134 | 0.059 | 0.010 | 0.148 | 0.197 | 0.0 | 62.7 | 67.5 | 0.990 | 64.0 | 0. | 0. | 0. | 0. | 4.7 |
| 135 | 0.060 | 0.010 | 0.150 | 0.200 | 0.0 | 64.1 | 66.7 | 0.980 | 65.0 | 0. | 0. | 0. | 0. | 4.8 |
| 136 | 0.060 | 0.010 | 0.150 | 0.200 | 0.0 | 63.2 | 70.8 | 0.970 | 67.3 | 0. | 0. | 0. | 0. | 4.9 |
| 137 | 0.060 | 0.010 | 0.150 | 0.200 | 0.0 | 67.0 | 71.0 | 0.940 | 70.0 | 0. | 0. | 0. | 0. | 4.9 |
| 138 | 0.060 | 0.010 | 0.150 | 0.200 | 0.0 | 69.8 | 74.6 | 0.910 | 75.0 | 0. | 0. | 0. | 0. | 5.0 |
| 139 | 0.060 | 0.010 | 0.150 | 0.200 | 0.0 | 75.0 | 75.4 | 0.860 | 77.0 | 0. | 0. | 0. | 0. | 5.1 |
| 140 | 0.060 | 0.010 | 0.150 | 0.200 | 0.0 | 76.2 | 78.8 | 0.820 | 78.0 | 0. | 0. | 102. | 0. | 5.3 |
| 141 | 0.060 | 0.010 | 0.150 | 0.200 | 0.0 | 75.2 | 79.5 | 0.730 | 77.3 | 0. | 0. | 359. | 0. | 5.4 |
| 142 | 0.060 | 0.010 | 0.150 | 0.200 | 0.0 | 72.6 | 78.8 | 0.610 | 75.3 | 0. | 0. | 365. | 0. | 5.5 |
| 143 | 0.060 | 0.010 | 0.150 | 0.200 | 0.0 | 71.1 | 73.7 | 0.450 | 73.0 | 0. | 0. | 1559. | 0. | 5.6 |
| 144 | 0.060 | 0.010 | 0.150 | 0.200 | 0.0 | 62.3 | 68.5 | 0.240 | 63.7 | 0. | 0. | 2296. | 0. | 5.7 |
| 145 | 0.060 | 0.010 | 0.150 | 0.200 | 0.0 | 72.7 | 73.2 | 0.240 | 75.0 | 0. | 0. | 3545. | 0. | 5.8 |
| 146 | 0.060 | 0.010 | 0.150 | 0.200 | 0.0 | 71.9 | 77.7 | 0.530 | 73.3 | 0. | 0. | 5375. | 0. | 5.9 |
| 147 | 0.060 | 0.010 | 0.150 | 0.200 | 0.0 | 71.1 | 76.8 | 0.750 | 73.7 | 0. | 0. | 7366. | 0. | 6.0 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 148 | 0.060 | 0.010 | 0.150 | 0.200 | 0.0 | 69.7 | 71.7 | 0.890 | 70.3 | 0. | 0. | 8967. | 0. | 6.0 |
| 149 | 0.060 | 0.010 | 0.150 | 0.200 | 0.0 | 69.6 | 72.2 | 0.960 | 72.3 | 0. | 0. | 10449. | 0. | 6.0 |
| 150 | 0.060 | 0.010 | 0.150 | 0.200 | 0.0 | 62.2 | 68.1 | 1.000 | 65.7 | 0. | 0. | 11489. | 0. | 6.0 |
| 151 | 0.060 | 0.010 | 0.150 | 0.200 | 0.0 | 62.5 | 68.6 | 1.000 | 66.3 | 0. | 0. | 12350. | 0. | 6.0 |
| 152 | 0.060 | 0.010 | 0.150 | 0.200 | 0.0 | 66.5 | 70.8 | 1.000 | 70.3 | 0. | 0. | 13051. | 0. | 6.0 |
| 153 | 0.060 | 0.010 | 0.150 | 0.200 | 0.0 | 69.1 | 74.3 | 1.000 | 72.7 | 0. | 0. | 13566. | 0. | 6.0 |
| 154 | 0.060 | 0.010 | 0.150 | 0.200 | 0.0 | 73.2 | 75.4 | 1.000 | 73.7 | 0. | 0. | 13859. | 0. | 6.0 |
| 155 | 0.060 | 0.010 | 0.150 | 0.200 | 0.0 | 76.1 | 79.7 | 1.000 | 77.3 | 0. | 0. | 14005. | 0. | 6.0 |
| 156 | 0.058 | 0.010 | 0.144 | 0.192 | 0.0 | 76.9 | 81.2 | 1.000 | 79.7 | 0. | 0. | 14005. | 0. | 6.0 |
| 157 | 0.055 | 0.009 | 0.138 | 0.184 | 0.0 | 76.4 | 81.2 | 1.000 | 79.7 | 0. | 0. | 14005. | 0. | 6.0 |
| 158 | 0.053 | 0.009 | 0.132 | 0.176 | 0.0 | 77.6 | 81.2 | 1.000 | 80.7 | 0. | 0. | 14005. | 0. | 6.0 |
| 159 | 0.050 | 0.008 | 0.126 | 0.168 | 0.0 | 76.8 | 79.6 | 1.000 | 77.3 | 0. | 0. | 14005. | 0. | 6.0 |
| 160 | 0.048 | 0.008 | 0.120 | 0.160 | 0.0 | 69.9 | 78.0 | 1.000 | 71.7 | 0. | 0. | 14005. | 0. | 6.0 |
| 161 | 0.046 | 0.008 | 0.114 | 0.152 | 0.0 | 71.5 | 73.5 | 1.000 | 73.0 | 0. | 0. | 14005. | 0. | 6.0 |
| 162 | 0.043 | 0.007 | 0.108 | 0.144 | 0.0 | 70.0 | 75.8 | 1.000 | 73.0 | 0. | 0. | 14005. | 0. | 6.0 |
| 163 | 0.041 | 0.007 | 0.102 | 0.136 | 0.0 | 74.1 | 76.9 | 0.990 | 77.3 | 0. | 0. | 14005. | 0. | 6.0 |
| 164 | 0.038 | 0.006 | 0.096 | 0.128 | 0.0 | 76.6 | 80.3 | 0.990 | 78.7 | 0. | 0. | 14005. | 0. | 6.0 |
| 165 | 0.036 | 0.006 | 0.090 | 0.120 | 0.0 | 78.6 | 81.9 | 0.980 | 81.0 | 0. | 0. | 14005. | 0. | 6.0 |
| 166 | 0.034 | 0.006 | 0.084 | 0.112 | 0.0 | 78.4 | 81.0 | 0.970 | 81.0 | 0. | 0. | 14005. | 0. | 6.0 |
| 167 | 0.031 | 0.005 | 0.078 | 0.104 | 0.0 | 78.2 | 82.2 | 0.940 | 79.7 | 0. | 0. | 14005. | 0. | 6.0 |
| 168 | 0.029 | 0.005 | 0.072 | 0.096 | 0.0 | 79.6 | 83.0 | 0.910 | 80.3 | 0. | 0. | 14005. | 0. | 6.0 |
| 169 | 0.026 | 0.004 | 0.066 | 0.088 | 0.0 | 79.7 | 83.7 | 0.860 | 81.3 | 0. | 0. | 14005. | 0. | 6.0 |
| 170 | 0.024 | 0.004 | 0.060 | 0.080 | 0.0 | 78.4 | 83.4 | 0.820 | 81.3 | 0. | 0. | 14005. | 0. | 6.0 |
| 171 | 0.022 | 0.004 | 0.054 | 0.072 | 0.0 | 78.2 | 82.0 | 0.730 | 80.3 | 0. | 0. | 14005. | 0. | 6.0 |
| 172 | 0.019 | 0.003 | 0.048 | 0.064 | 0.0 | 75.4 | 80.9 | 0.610 | 78.0 | 0. | 0. | 14005. | 0. | 6.0 |
| 173 | 0.017 | 0.003 | 0.042 | 0.056 | 0.0 | 76.7 | 81.6 | 0.450 | 80.3 | 0. | 0. | 14005. | 0. | 6.0 |
| 174 | 0.014 | 0.002 | 0.036 | 0.048 | 0.0 | 75.9 | 81.1 | 0.240 | 80.7 | 0. | 0. | 14005. | 0. | 6.0 |
| 175 | 0.012 | 0.002 | 0.030 | 0.040 | 0.0 | 74.9 | 78.6 | 0.240 | 75.0 | 0. | 0. | 14005. | 0. | 6.0 |
| 176 | 0.010 | 0.002 | 0.024 | 0.032 | 0.0 | 73.3 | 75.0 | 0.530 | 73.0 | 0. | 0. | 14005. | 0. | 6.0 |
| 177 | 0.007 | 0.001 | 0.018 | 0.024 | 0.0 | 71.9 | 75.2 | 0.750 | 71.3 | 0. | 0. | 14005. | 0. | 6.0 |
| 178 | 0.005 | 0.001 | 0.012 | 0.016 | 0.0 | 69.2 | 71.9 | 0.890 | 70.0 | 0. | 0. | 14005. | 0. | 6.0 |
| 179 | 0.002 | 0.000 | 0.006 | 0.008 | 0.0 | 71.5 | 76.6 | 0.960 | 73.0 | 0. | 0. | 14005. | 0. | 6.0 |
| 180 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 74.5 | 79.2 | 1.000 | 76.7 | 0. | 0. | 14005. | 0. | 6.0 |
| 181 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 72.2 | 78.3 | 1.000 | 74.3 | 0. | 0. | 14005. | 0. | 6.0 |
| 182 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 71.6 | 73.9 | 1.000 | 71.7 | 0. | 0. | 14005. | 0. | 6.0 |
| 183 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 74.4 | 76.8 | 1.000 | 77.3 | 0. | 0. | 14005. | 0. | 6.0 |
| 184 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 74.6 | 79.7 | 1.000 | 76.3 | 0. | 0. | 14005. | 0. | 6.0 |
| 185 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 74.7 | 79.3 | 1.000 | 76.7 | 0. | 0. | 14005. | 0. | 6.0 |
| 186 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 76.3 | 81.0 | 1.000 | 80.3 | 0. | 0. | 14005. | 0. | 6.0 |
| 187 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 76.6 | 81.1 | 1.000 | 78.7 | 0. | 0. | 14005. | 0. | 6.0 |
| 188 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 77.3 | 81.7 | 1.000 | 80.3 | 0. | 0. | 14005. | 0. | 6.0 |
| 189 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 78.5 | 82.0 | 1.000 | 80.0 | 0. | 0. | 14005. | 0. | 6.0 |
| 190 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 78.7 | 83.3 | 1.000 | 81.0 | 0. | 0. | 14005. | 0. | 6.0 |
| 191 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 73.9 | 78.5 | 1.000 | 74.0 | 0. | 0. | 14005. | 0. | 6.0 |
| 192 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 75.7 | 79.2 | 0.990 | 78.7 | 0. | 0. | 14005. | 0. | 6.0 |
| 193 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 70.7 | 76.6 | 0.990 | 72.0 | 0. | 0. | 14005. | 0. | 6.0 |
| 194 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 72.6 | 78.0 | 0.980 | 77.0 | 0. | 0. | 14005. | 0. | 6.0 |
| 195 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 70.2 | 75.1 | 0.970 | 71.0 | 0. | 0. | 14005. | 0. | 6.0 |
| 196 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 72.7 | 76.2 | 0.940 | 75.0 | 0. | 0. | 14005. | 0. | 6.0 |
| 197 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 74.5 | 77.6 | 0.910 | 77.3 | 0. | 0. | 14005. | 0. | 6.0 |
| 198 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 74.2 | 78.4 | 0.860 | 75.7 | 0. | 0. | 14005. | 0. | 6.0 |
| 199 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 76.9 | 79.7 | 0.820 | 79.7 | 0. | 0. | 14005. | 0. | 6.0 |
| 200 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 76.4 | 80.7 | 0.730 | 80.3 | 0. | 0. | 14005. | 0. | 6.0 |
| 201 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 77.6 | 81.2 | 0.610 | 80.7 | 0. | 0. | 14005. | 0. | 6.0 |
| 202 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 77.5 | 84.0 | 0.450 | 81.2 | 0. | 0. | 14005. | 0. | 6.0 |
| 203 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 77.5 | 84.0 | 0.240 | 81.2 | 0. | 0. | 14005. | 0. | 6.0 |
| 204 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 77.6 | 84.0 | 0.240 | 81.2 | 0. | 0. | 14005. | 0. | 6.0 |
| 205 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 76.9 | 84.3 | 0.530 | 81.0 | 0. | 0. | 14005. | 0. | 6.0 |

NATURAL MORTALITY

| EGGS 1-3 | LARVAE 4-5 | LARVAE | PUPAE | AOULTS |
|---|---|---|---|---|
| 0.045 | 0.040 | 0.040 | 0.030 | 0.150 |

| OAYNO. | POSPAR | POSPRD | POS1-3 | POS4-5 | POSPUP | POSAOT | POSEGG | EGG | 1-3 | 4-5 | PUP | ADP | ADO | E-E | EGLYPR | EGLYCR | PRMGRT | SEXPTO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | BOLLWORM | HELIOTHIS | | ZEA | | | | | | | | | | | | |
| 82 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 10 | 21 | 27 | 34 | 2 | 11 | 94 | 0.370 | 0.500 | 0.0 | 0.25 |
| 83 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 13 | 23 | 27 | 34 | 3 | 13 | 100 | 0.132 | 0.510 | 0.0 | 0.26 |
| 84 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 13 | 23 | 27 | 33 | 3 | 13 | 99 | 0.325 | 0.524 | 0.0 | 0.27 |
| 85 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 13 | 23 | 27 | 33 | 3 | 13 | 99 | 0.433 | 0.536 | 0.0 | 0.29 |
| 86 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 12 | 22 | 27 | 32 | 2 | 10 | 95 | 0.554 | 0.556 | 0.0 | 0.31 |
| 87 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 13 | 22 | 27 | 32 | 3 | 14 | 97 | 0.011 | 0.564 | 0.0 | 0.32 |
| 88 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 13 | 22 | 26 | 32 | 6 | 18 | 99 | 0.011 | 0.564 | 0.0 | 0.32 |
| 89 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 12 | 21 | 25 | 31 | 5 | 17 | 94 | 0.011 | 0.565 | 0.0 | 0.32 |
| 90 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 11 | 20 | 24 | 30 | 4 | 16 | 89 | 0.011 | 0.567 | 0.0 | 0.32 |
| 91 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 10 | 19 | 24 | 29 | 3 | 14 | 85 | 0.267 | 0.573 | 0.0 | 0.33 |
| 92 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 10 | 19 | 23 | 28 | 3 | 14 | 83 | 0.011 | 0.580 | 0.0 | 0.34 |
| 93 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 9 | 18 | 22 | 27 | 5 | 16 | 81 | 0.011 | 0.582 | 0.0 | 0.34 |
| 94 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 9 | 17 | 21 | 26 | 4 | 15 | 77 | 0.112 | 0.586 | 0.0 | 0.34 |
| 95 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 8 | 17 | 20 | 26 | 3 | 13 | 74 | 0.225 | 0.592 | 0.0 | 0.35 |
| 96 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 9 | 16 | 20 | 25 | 3 | 12 | 73 | 0.403 | 0.600 | 0.0 | 0.36 |
| 97 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 10 | 16 | 19 | 25 | 3 | 12 | 73 | 0.398 | 0.608 | 0.0 | 0.37 |
| 98 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 10 | 16 | 19 | 24 | 3 | 13 | 72 | 0.307 | 0.614 | 0.0 | 0.38 |
| 99 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 9 | 15 | 18 | 24 | 2 | 11 | 68 | 0.514 | 0.622 | 0.0 | 0.39 |
| 100 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 9 | 15 | 18 | 24 | 3 | 12 | 69 | 0.314 | 0.629 | 0.0 | 0.40 |
| 101 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 8 | 14 | 17 | 23 | 3 | 13 | 65 | 0.240 | 0.633 | 0.0 | 0.40 |
| 102 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 8 | 14 | 16 | 22 | 3 | 14 | 63 | 0.241 | 0.636 | 0.0 | 0.40 |
| 103 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 8 | 13 | 16 | 22 | 3 | 14 | 62 | 0.067 | 0.638 | 0.0 | 0.41 |
| 104 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 7 | 12 | 15 | 21 | 3 | 14 | 58 | 0.122 | 0.640 | 0.0 | 0.41 |
| 105 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 6 | 11 | 14 | 20 | 3 | 14 | 54 | 0.310 | 0.643 | 0.0 | 0.41 |
| 106 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 6 | 11 | 14 | 19 | 3 | 12 | 53 | 0.478 | 0.646 | 0.0 | 0.42 |
| 107 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 6 | 10 | 13 | 19 | 2 | 10 | 50 | 0.649 | 0.651 | 0.0 | 0.42 |
| 108 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 6 | 10 | 13 | 19 | 2 | 10 | 50 | 0.654 | 0.656 | 0.0 | 0.43 |
| 109 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 6 | 10 | 13 | 19 | 3 | 12 | 51 | 0.362 | 0.658 | 0.0 | 0.43 |
| 110 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5 | 10 | 13 | 18 | 3 | 12 | 49 | 0.375 | 0.659 | 0.0 | 0.43 |
| 111 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5 | 9 | 13 | 18 | 3 | 13 | 48 | 0.285 | 0.661 | 0.0 | 0.44 |
| 112 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4 | 9 | 12 | 17 | 2 | 11 | 44 | 0.615 | 0.662 | 0.0 | 0.44 |
| 113 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4 | 9 | 12 | 17 | 2 | 10 | 44 | 0.661 | 0.663 | 0.0 | 0.44 |
| 114 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4 | 9 | 12 | 17 | 2 | 9 | 44 | 0.661 | 0.663 | 0.0 | 0.44 |
| 115 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4 | 9 | 12 | 18 | 2 | 9 | 45 | 0.660 | 0.662 | 0.0 | 0.44 |
| 116 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4 | 9 | 12 | 18 | 2 | 9 | 45 | 0.658 | 0.660 | 0.0 | 0.44 |
| 117 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5 | 9 | 12 | 19 | 2 | 9 | 47 | 0.656 | 0.657 | 0.0 | 0.43 |
| 118 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5 | 9 | 12 | 19 | 2 | 11 | 47 | 0.496 | 0.655 | 0.0 | 0.43 |
| 119 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5 | 9 | 12 | 19 | 2 | 10 | 47 | 0.460 | 0.652 | 0.0 | 0.43 |
| 120 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5 | 9 | 12 | 19 | 2 | 11 | 47 | 0.525 | 0.649 | 0.0 | 0.42 |
| 121 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4 | 9 | 12 | 19 | 2 | 10 | 46 | 0.643 | 0.645 | 0.0 | 0.42 |
| 122 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4 | 9 | 12 | 19 | 2 | 10 | 46 | 0.638 | 0.640 | 0.0 | 0.41 |
| 123 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4 | 9 | 12 | 18 | 2 | 10 | 45 | 0.633 | 0.635 | 0.0 | 0.40 |
| 124 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4 | 9 | 13 | 18 | 2 | 10 | 46 | 0.369 | 0.630 | 0.0 | 0.40 |
| 125 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4 | 9 | 13 | 18 | 2 | 10 | 46 | 0.622 | 0.624 | 0.0 | 0.39 |
| 126 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4 | 9 | 13 | 18 | 2 | 9 | 46 | 0.615 | 0.617 | 0.0 | 0.38 |
| 127 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4 | 10 | 13 | 18 | 2 | 10 | 47 | 0.357 | 0.611 | 0.0 | 0.37 |
| 128 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5 | 10 | 13 | 18 | 2 | 11 | 48 | 0.323 | 0.605 | 0.0 | 0.37 |
| 129 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5 | 10 | 13 | 18 | 2 | 10 | 48 | 0.596 | 0.598 | 0.0 | 0.36 |
| 130 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5 | 10 | 13 | 18 | 2 | 10 | 48 | 0.590 | 0.592 | 0.0 | 0.35 |
| 131 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5 | 10 | 12 | 18 | 2 | 11 | 47 | 0.323 | 0.586 | 0.0 | 0.34 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 132 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5 | 9 | 12 | 18 | 2 | 10 | 46 | 0.578 | 0.579 | 0.0 | 0.34 |
| 133 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5 | 9 | 12 | 18 | 2 | 10 | 46 | 0.571 | 0.573 | 0.0 | 0.33 |
| 134 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5 | 9 | 12 | 18 | 3 | 12 | 47 | 0.303 | 0.568 | 0.0 | 0.32 |
| 135 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5 | 8 | 12 | 18 | 3 | 12 | 46 | 0.330 | 0.563 | 0.0 | 0.32 |
| 136 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4 | 8 | 11 | 18 | 2 | 11 | 43 | 0.393 | 0.557 | 0.0 | 0.31 |
| 137 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4 | 8 | 11 | 17 | 2 | 11 | 42 | 0.465 | 0.552 | 0.0 | 0.30 |
| 138 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4 | 8 | 11 | 17 | 2 | 10 | 42 | 0.544 | 0.545 | 0.0 | 0.30 |
| 139 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4 | 8 | 11 | 17 | 2 | 10 | 42 | 0.537 | 0.539 | 0.0 | 0.29 |
| 140 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3 | 8 | 11 | 17 | 2 | 9 | 41 | 0.504 | 0.533 | 0.0 | 0.28 |
| 141 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4 | 8 | 12 | 17 | 2 | 9 | 43 | 0.593 | 0.594 | 0.0 | 0.35 |
| 142 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4 | 9 | 12 | 17 | 2 | 9 | 44 | 0.752 | 0.754 | 0.0 | 0.57 |
| 143 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4 | 9 | 13 | 17 | 2 | 10 | 45 | 0.844 | 0.846 | 0.0 | 0.72 |
| 144 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4 | 10 | 12 | 16 | 2 | 11 | 44 | 0.465 | 0.900 | 0.0 | 0.81 |
| 145 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4 | 9 | 12 | 16 | 2 | 10 | 43 | 0.946 | 0.949 | 0.0 | 0.90 |
| 146 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4 | 9 | 12 | 16 | 2 | 9 | 43 | 0.982 | 0.984 | 0.0 | 0.97 |
| 147 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5 | 9 | 11 | 16 | 2 | 9 | 43 | 0.996 | 0.999 | 0.0 | 1.00 |
| 148 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5 | 9 | 11 | 16 | 2 | 11 | 43 | 0.857 | 0.997 | 0.0 | 0.99 |
| 149 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5 | 9 | 11 | 16 | 2 | 10 | 43 | 0.979 | 0.982 | 0.0 | 0.96 |
| 150 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5 | 8 | 11 | 15 | 3 | 11 | 42 | 0.594 | 0.958 | 0.0 | 0.92 |
| 151 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5 | 8 | 10 | 15 | 2 | 11 | 40 | 0.604 | 0.924 | 0.0 | 0.85 |
| 152 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4 | 7 | 10 | 14 | 2 | 11 | 37 | 0.749 | 0.871 | 0.0 | 0.76 |
| 153 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4 | 7 | 10 | 14 | 2 | 10 | 37 | 0.784 | 0.787 | 0.0 | 0.62 |
| 154 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4 | 7 | 10 | 14 | 2 | 10 | 37 | 0.661 | 0.663 | 0.027 | 0.44 |
| 155 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3 | 7 | 10 | 14 | 2 | 9 | 36 | 0.606 | 0.608 | 0.067 | 0.37 |
| 156 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3 | 7 | 10 | 13 | 2 | 8 | 35 | 0.496 | 0.577 | 0.108 | 0.33 |
| 157 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3 | 7 | 10 | 13 | 2 | 8 | 35 | 0.471 | 0.547 | 0.148 | 0.30 |
| 158 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3 | 7 | 10 | 13 | 2 | 8 | 35 | 0.418 | 0.517 | 0.189 | 0.27 |
| 159 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4 | 7 | 9 | 13 | 2 | 9 | 35 | 0.486 | 0.487 | 0.229 | 0.24 |
| 160 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4 | 7 | 9 | 13 | 2 | 9 | 35 | 0.426 | 0.458 | 0.268 | 0.21 |
| 161 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4 | 7 | 9 | 13 | 2 | 10 | 35 | 0.433 | 0.434 | 0.300 | 0.19 |
| 162 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4 | 7 | 9 | 13 | 2 | 10 | 35 | 0.407 | 0.408 | 0.336 | 0.17 |
| 163 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3 | 6 | 9 | 13 | 2 | 9 | 33 | 0.380 | 0.381 | 0.373 | 0.14 |
| 164 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3 | 6 | 8 | 12 | 2 | 8 | 31 | 0.321 | 0.352 | 0.412 | 0.12 |
| 165 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3 | 6 | 8 | 13 | 2 | 8 | 32 | 0.255 | 0.323 | 0.453 | 0.10 |
| 166 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3 | 6 | 8 | 13 | 2 | 8 | 32 | 0.232 | 0.293 | 0.495 | 0.09 |
| 167 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3 | 6 | 8 | 13 | 2 | 8 | 32 | 0.227 | 0.263 | 0.536 | 0.07 |
| 168 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3 | 6 | 8 | 14 | 2 | 8 | 33 | 0.194 | 0.235 | 0.577 | 0.06 |
| 169 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3 | 6 | 9 | 14 | 2 | 8 | 34 | 0.160 | 0.207 | 0.600 | 0.04 |
| 170 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3 | 6 | 9 | 14 | 2 | 8 | 34 | 0.139 | 0.180 | 0.600 | 0.03 |
| 171 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3 | 7 | 10 | 14 | 2 | 8 | 36 | 0.137 | 0.166 | 0.600 | 0.02 |
| 172 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3 | 7 | 10 | 15 | 2 | 8 | 37 | 0.157 | 0.166 | 0.600 | 0.02 |
| 173 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3 | 7 | 10 | 15 | 2 | 8 | 37 | 0.137 | 0.166 | 0.600 | 0.01 |
| 174 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4 | 8 | 10 | 15 | 2 | 8 | 39 | 0.134 | 0.166 | 0.600 | 0.01 |
| 175 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4 | 8 | 10 | 15 | 2 | 9 | 39 | 0.0 | 0.166 | 0.600 | 0.00 |
| 176 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4 | 8 | 10 | 14 | 2 | 10 | 38 | 0.0 | 0.166 | 0.600 | ******* |
| 177 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4 | 8 | 10 | 14 | 2 | 10 | 38 | 0.0 | 0.166 | 0.600 | 1.06 |
| 178 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4 | 8 | 10 | 14 | 2 | 10 | 38 | 0.0 | 0.166 | 0.600 | 0.00 |
| 179 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4 | 7 | 10 | 14 | 2 | 9 | 37 | 0.0 | 0.166 | 0.600 | -0.14 |
| 180 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4 | 7 | 9 | 14 | 2 | 9 | 36 | 0.0 | 0.166 | 0.600 | ******* |
| 181 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4 | 7 | 9 | 14 | 2 | 9 | 36 | 0.0 | 0.166 | 0.600 | -0.00 |
| 182 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4 | 7 | 9 | 14 | 2 | 10 | 36 | 0.0 | 0.166 | 0.600 | -0.00 |
| 183 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4 | 7 | 9 | 14 | 2 | 9 | 36 | 0.0 | 0.166 | 0.600 | -0.00 |
| 184 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3 | 7 | 9 | 14 | 2 | 9 | 35 | 0.0 | 0.166 | 0.600 | -0.00 |
| 185 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3 | 6 | 9 | 14 | 2 | 9 | 34 | 0.0 | 0.166 | 0.600 | -0.00 |
| 186 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3 | 6 | 9 | 14 | 2 | 8 | 34 | 0.0 | 0.166 | 0.600 | -0.00 |
| 187 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3 | 6 | 9 | 14 | 2 | 8 | 34 | 0.0 | 0.166 | 0.600 | ******* |
| 188 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3 | 7 | 9 | 14 | 2 | 8 | 35 | 0.0 | 0.166 | 0.600 | -0.00 |
| 189 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3 | 7 | 10 | 14 | 2 | 8 | 36 | 0.0 | 0.166 | 0.600 | -0.00 |
| 190 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3 | 7 | 10 | 14 | 2 | 8 | 36 | 0.0 | 0.166 | 0.600 | -0.00 |
| 191 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4 | 7 | 10 | 14 | 2 | 9 | 37 | 0.0 | 0.166 | 0.600 | ******* |
| 192 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4 | 7 | 10 | 14 | 2 | 9 | 37 | 0.0 | 0.166 | 0.600 | -0.00 |
| 193 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4 | 7 | 10 | 13 | 2 | 9 | 36 | 0.0 | 0.166 | 0.600 | ******* |
| 194 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4 | 7 | 9 | 13 | 2 | 9 | 35 | 0.0 | 0.166 | 0.600 | ******* |
| 195 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4 | 7 | 9 | 13 | 2 | 10 | 35 | 0.0 | 0.166 | 0.600 | -0.00 |
| 196 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4 | 7 | 9 | 13 | 2 | 9 | 35 | 0.0 | 0.166 | 0.600 | -0.00 |
| 197 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4 | 7 | 9 | 13 | 2 | 9 | 35 | 0.0 | 0.166 | 0.600 | 0.00 |
| 198 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3 | 6 | 9 | 12 | 2 | 9 | 32 | 0.0 | 0.166 | 0.600 | 0.00 |
| 199 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3 | 6 | 8 | 12 | 2 | 9 | 31 | 0.0 | 0.166 | 0.600 | -0.00 |
| 200 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3 | 6 | 8 | 12 | 2 | 8 | 31 | 0.0 | 0.166 | 0.600 | -0.00 |
| 201 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3 | 6 | 8 | 12 | 2 | 8 | 31 | 0.0 | 0.166 | 0.600 | -0.00 |
| 202 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3 | 6 | 8 | 12 | 2 | 8 | 31 | 0.0 | 0.166 | 0.600 | ******* |
| 203 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3 | 6 | 8 | 12 | 2 | 8 | 31 | 0.0 | 0.166 | 0.600 | ******* |
| 204 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3 | 6 | 8 | 12 | 2 | 8 | 31 | 0.0 | 0.166 | 0.600 | ******* |
| 205 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3 | 6 | 8 | 12 | 2 | 7 | 31 | 0.0 | 0.166 | 0.600 | ******* |

| KK | I | SITES | PRBLAR | PR8NEW |
|---|---|---|---|---|
| 82 | 0 | 16479. | 0.0 | 0.0 |
| 83 | 0 | 17022. | 0.0 | 0.0 |
| 84 | 0 | 17796. | 0.0 | 0.0 |
| 85 | 0 | 18539. | 0.0 | 0.0 |
| 86 | 0 | 19904. | 0.0 | 0.0 |
| 87 | 0 | 20506. | 0.0 | 0.0 |
| 88 | 0 | 20506. | 0.0 | 0.0 |
| 89 | 0 | 20600. | 0.0 | 0.0 |
| 90 | 0 | 20741. | 0.0 | 0.0 |
| 91 | 0 | 21303. | 0.0 | 0.0 |
| 92 | 0 | 21839. | 0.0 | 0.0 |
| 93 | 0 | 22030. | 0.0 | 0.0 |
| 94 | 111 | 22371. | 0.0 | 0.0 |
| 95 | 113 | 22926. | 0.0 | 0.0 |
| 96 | 113 | 23822. | 0.0 | 0.0 |
| 82 | 114 | 16479. | 0.0 | 0.0 |
| 83 | 115 | 17022. | 0.0 | 0.0 |
| 85 | 114 | 18539. | 0.0 | 0.0 |
| 86 | 115 | 19904. | 0.0 | 0.0 |
| 88 | 117 | 20506. | 0.0 | 0.0 |
| 89 | 118 | 20600. | 0.0 | 0.0 |
| 91 | 118 | 21303. | 0.0 | 0.0 |
| 93 | 118 | 22030. | 0.0 | 0.0 |
| 95 | 118 | 22926. | 0.0 | 0.0 |
| 96 | 118 | 23822. | 0.0 | 0.0 |
| 98 | 117 | 25397. | 0.0 | 0.0 |
| 99 | 118 | 26489. | 0.0 | 0.0 |
| 100 | 121 | 27378. | 0.0 | 0.001 |
| 101 | 121 | 28008. | 0.0 | 0.001 |
| 103 | 122 | 28989. | 0.000 | 0.001 |
| 104 | 121 | 29395. | 0.001 | 0.003 |
| 105 | 122 | 29918. | 0.002 | 0.005 |
| 106 | 123 | 30731. | 0.004 | 0.007 |
| 107 | 124 | 31973. | 0.006 | 0.006 |
| 108 | 125 | 33415. | 0.008 | 0.006 |
| 109 | 126 | 34247. | 0.009 | 0.010 |
| 110 | 127 | 35101. | 0.011 | 0.025 |
| 111 | 128 | 35825. | 0.019 | 0.015 |
| 112 | 129 | 36585. | 0.022 | 0.018 |
| 113 | 129 | 38328. | 0.0 | 0.021 |
| 114 | 131 | 39828. | 0.029 | 0.014 |
| 115 | 132 | 41348. | 0.029 | 0.003 |
| 116 | 133 | 42902. | 0.024 | 0.004 |
| 117 | 134 | 44431. | 0.020 | 0.009 |

| | | | | |
|---|---|---|---|---|
| 118 | 135 | 45475. | 0.019 | 0.006 |
| 118 | 137 | 45475. | 0.013 | 0.002 |
| 119 | 138 | 46767. | 0.014 | 0.002 |
| 120 | 139 | 47884. | 0.011 | 0.001 |
| 121 | 140 | 49121. | 0.009 | 0.001 |
| 122 | 142 | 50469. | 0.007 | 0.002 |
| 124 | 140 | 53157. | 0.005 | 0.003 |
| 125 | 142 | 54453. | 0.005 | 0.003 |
| 126 | 144 | 55989. | 0.005 | 0.005 |
| 128 | 144 | 58614. | 0.006 | 0.006 |
| 129 | 144 | 59922. | 0.007 | 0.001 |
| 130 | 145 | 61206. | 0.006 | 0.007 |
| 131 | 146 | 62304. | 0.007 | 0.006 |
| 132 | 146 | 63574. | 0.008 | 0.007 |
| 133 | 147 | 64884. | 0.009 | 0.007 |
| 134 | 148 | 65870. | 0.010 | 0.005 |
| 134 | 150 | 65870. | 0.010 | 0.004 |
| 135 | 152 | 66813. | 0.009 | 0.002 |
| 135 | 146 | 66813. | 0.0 | 0.001 |
| 137 | 154 | 69174. | 0.006 | 0.001 |
| 141 | 152 | 360. | 0.074 | 0.094 |
| 142 | 153 | 866. | 0.043 | 0.022 |
| 143 | 154 | 1560. | 0.027 | 0.020 |
| 144 | 155 | 2297. | 0.017 | 0.012 |
| 146 | 156 | 5376. | 0.010 | 0.0 |
| 147 | 154 | 7367. | 0.0 | 0.007 |
| 148 | 157 | 8968. | 0.004 | 0.028 |
| 149 | 158 | 10450. | 0.006 | 0.035 |
| 150 | 159 | 11490. | 0.009 | 0.040 |
| 151 | 160 | 12351. | 0.012 | 0.053 |
| 152 | 161 | 13052. | 0.017 | 0.018 |
| 153 | 162 | 13567. | 0.014 | 0.027 |
| 154 | 163 | 13860. | 0.014 | 0.065 |
| 155 | 164 | 13905. | 0.024 | 0.092 |
| 156 | 165 | 13648. | 0.039 | 0.107 |
| 157 | 166 | 13141. | 0.065 | 0.208 |
| 158 | 164 | 12448. | 0.0 | 0.292 |
| 160 | 167 | 10461. | 0.247 | 0.565 |
| 161 | 168 | 8632. | 0.373 | 0.469 |
| 162 | 168 | 6640. | 0.257 | 0.419 |
| 163 | 170 | 5040. | 0.284 | 0.339 |
| 164 | 170 | 3557. | 0.286 | 0.292 |
| 165 | 171 | 2518. | 0.306 | 0.252 |
| 166 | 172 | 1657. | 0.310 | 0.258 |
| 167 | 173 | 555. | 0.427 | 0.391 |
| 167 | 175 | 955. | 0.476 | 0.204 |
| 168 | 176 | 441. | 0.461 | 0.281 |
| 169 | 177 | 148. | 0.464 | 0.422 |
| 170 | 178 | 1. | 0.458 | 0.578 |
| 171 | 179 | 1. | 0.344 | 0.0 |
| 172 | 180 | 1. | 0.220 | 0.571 |
| 173 | 179 | 1. | 0.0 | 0.574 |
| 174 | 182 | 1. | 0.007 | 0.952 |
| 175 | 183 | 1. | 0.0 | 0.913 |
| 176 | 182 | 1. | 0.0 | 0.905 |
| 177 | 183 | 1. | 0.0 | 0.887 |
| 178 | 183 | 1. | 0.0 | 0.0 |
| 179 | 185 | 1. | 0.0 | 0.808 |
| 180 | 186 | 1. | 0.0 | 0.779 |
| 182 | 187 | 1. | 0.0 | 0.0 |
| 183 | 188 | 1. | 0.0 | 0.0 |
| 184 | 188 | 1. | 0.0 | 0.0 |
| 184 | 190 | 1. | 0.0 | 0.0 |
| 185 | 191 | 1. | 0.0 | 0.0 |
| 186 | 191 | 1. | 0.0 | 0.0 |
| 187 | 193 | 1. | 0.0 | 0.0 |
| 188 | 194 | 1. | 0.0 | 0.0 |
| 189 | 195 | 1. | 0.0 | 0.0 |
| 190 | 196 | 1. | 0.0 | 0.0 |
| 191 | 196 | 1. | 0.0 | 0.0 |
| 192 | 196 | 1. | 0.0 | 0.0 |
| 193 | 196 | 1. | 0.0 | 0.0 |
| 195 | 196 | 1. | 0.0 | 0.0 |
| 196 | 196 | 1. | 0.0 | 0.0 |
| 197 | 196 | 1. | 0.0 | 0.0 |
| 198 | 196 | 1. | 0.0 | 0.0 |
| 199 | 196 | 1. | 0.0 | 0.0 |
| 200 | 196 | 1. | 0.0 | 0.0 |
| 201 | 196 | 1. | 0.0 | 0.0 |
| 202 | 196 | 1. | 0.0 | 0.0 |

PRINTOUT OF TOTAL POPULATION OF VARIOUS LIFE STAGES ON ANY DAY
BOLLWORM HELIOTHIS ZEA

| DAY NO. | EGGS | 1ST-3RD | 4TH-5TH | PUPAE | P AOULT | O AOULT | INPUT | EQELAD | MIGRATS | IN EGGS | PAR EGG | TOTMGS | TRICHS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 82 | 0. | 0. | 0. | 0. | 0. | 0. | 11. | 0. | 0. | 0. | 0. | 0. | 0.0 |
| 83 | 760. | 0. | 0. | 0. | 0. | 0. | 8. | 0. | 0. | 76. | 0. | 0. | 0.0 |
| 84 | 1318. | 0. | 0. | 0. | 0. | 0. | 6. | 0. | 0. | 131. | 1. | 0. | 0.0 |
| 85 | 1696. | 0. | 0. | 0. | 0. | 0. | 2. | 0. | 0. | 167. | 1. | 0. | 0.0 |
| 86 | 1756. | 0. | 0. | 0. | 0. | 0. | 2. | 0. | 0. | 172. | 2. | 0. | 0.0 |
| 87 | 1758. | 0. | 0. | 0. | 0. | 0. | 1. | 0. | 0. | 171. | 3. | 0. | 0.0 |
| 88 | 1733. | 0. | 0. | 0. | 0. | 0. | 3. | 0. | 0. | 166. | 4. | 0. | 0.0 |
| 89 | 1822. | 0. | 0. | 0. | 0. | 0. | 6. | 0. | 0. | 173. | 5. | 0. | 0.0 |
| 90 | 2131. | 0. | 0. | 0. | 0. | 0. | 8. | 0. | 0. | 202. | 5. | 0. | 0.0 |
| 91 | 2583. | 0. | 0. | 0. | 0. | 0. | 9. | 0. | 0. | 244. | 6. | 0. | 0.0 |
| 92 | 3037. | 0. | 0. | 0. | 0. | 0. | 6. | 0. | 0. | 286. | 6. | 0. | 0.0 |
| 93 | 3246. | 0. | 0. | 0. | 0. | 0. | 3. | 0. | 0. | 303. | 7. | 0. | 0.0 |
| 94 | 3155. | 7. | 0. | 0. | 0. | 0. | 3. | 0. | 0. | 294. | 8. | 0. | 0.0 |
| 95 | 2909. | 54. | 0. | 0. | 0. | 0. | 4. | 0. | 0. | 275. | 10. | 0. | 0.0 |
| 96 | 2749. | 171. | 0. | 0. | 0. | 0. | 14. | 0. | 0. | 258. | 12. | 0. | 0.0 |
| 97 | 3407. | 303. | 0. | 0. | 0. | 0. | 22. | 0. | 0. | 319. | 11. | 0. | 0.0 |
| 98 | 4736. | 420. | 0. | 0. | 0. | 0. | 29. | 0. | 0. | 435. | 10. | 0. | 0.0 |
| 99 | 6454. | 449. | 0. | 0. | 0. | 0. | 20. | 0. | 0. | 600. | 9. | 0. | 0.0 |
| 100 | 7134. | 524. | 0. | 0. | 0. | 0. | 11. | 0. | 0. | 663. | 10. | 0. | 0.0 |
| 101 | 6959. | 662. | 0. | 0. | 0. | 0. | 2. | 0. | 0. | 635. | 12. | 0. | 0.0 |
| 102 | 6104. | 794. | 0. | 0. | 0. | 0. | 12. | 0. | 0. | 535. | 15. | 0. | 0.0 |
| 103 | 6268. | 852. | 0. | 0. | 0. | 0. | 23. | 0. | 0. | 537. | 15. | 0. | 0.0 |
| 104 | 7299. | 844. | 0. | 0. | 0. | 0. | 34. | 0. | 0. | 631. | 14. | 0. | 0.0 |
| 105 | 9197. | 845. | 0. | 0. | 0. | 0. | 25. | 0. | 0. | 805. | 13. | 0. | 0.0 |
| 106 | 9768. | 840. | 0. | 0. | 0. | 0. | 14. | 0. | 0. | 869. | 14. | 0. | 0.0 |
| 107 | 8780. | 1023. | 0. | 0. | 0. | 0. | 2. | 0. | 0. | 816. | 17. | 0. | 0.0 |
| 108 | 7135. | 1671. | 0. | 0. | 0. | 0. | 2. | 0. | 0. | 622. | 21. | 0. | 0.0 |
| 109 | 5636. | 2019. | 1. | 0. | 0. | 0. | 4. | 0. | 0. | 476. | 26. | 0. | 0.0 |
| 110 | 4241. | 2334. | 5. | 0. | 0. | 0. | 8. | 0. | 0. | 372. | 34. | 0. | 0.0 |
| 111 | 3428. | 2841. | 26. | 0. | 0. | 0. | 10. | 0. | 0. | 294. | 39. | 0. | 0.0 |
| 112 | 3213. | 3220. | 71. | 0. | 0. | 0. | 7. | 0. | 0. | 251. | 39. | 0. | 0.0 |
| 113 | 3255. | 3282. | 145. | 0. | 0. | 0. | 4. | 0. | 0. | 219. | 36. | 0. | 0.0 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 114 | 2776. | 2988. | 241. | 0. | 0. | 0. | 2. | 0. | 0. | 190. | 39. | 0. | 0.0 |
| 115 | 2057. | 2832. | 331. | 0. | 0. | 0. | 3. | 0. | 0. | 159. | 48. | 0. | 0.0 |
| 116 | 1677. | 2878. | 417. | 0. | 0. | 0. | 5. | 0. | 0. | 114. | 53. | 0. | 0.0 |
| 117 | 1639. | 2472. | 573. | 0. | 0. | 0. | 7. | 0. | 0. | 102. | 49. | 0. | 0.0 |
| 118 | 1835. | 2137. | 996. | 0. | 0. | 0. | 8. | 0. | 0. | 120. | 40. | 0. | 0.0 |
| 119 | 2062. | 1687. | 1231. | 0. | 0. | 0. | 8. | 0. | 0. | 150. | 34. | 0. | 0.0 |
| 120 | 2417. | 1244. | 1527. | 0. | 0. | 0. | 9. | 0. | 0. | 175. | 27. | 0. | 0.0 |
| 121 | 2630. | 851. | 1866. | 0. | 0. | 0. | 13. | 0. | 0. | 214. | 25. | 0. | 0.0 |
| 122 | 3058. | 859. | 2064. | 2. | 0. | 0. | 18. | 0. | 0. | 257. | 22. | 0. | 0.0 |
| 123 | 3641. | 847. | 2017. | 10. | 0. | 0. | 21. | 0. | 0. | 325. | 18. | 0. | 0.0 |
| 124 | 4121. | 772. | 1967. | 38. | 0. | 0. | 23. | 0. | 0. | 394. | 17. | 0. | 0.1 |
| 125 | 4734. | 959. | 2020. | 85. | 0. | 0. | 22. | 0. | 0. | 442. | 17. | 0. | 0.1 |
| 126 | 5007. | 1162. | 2023. | 149. | 0. | 0. | 19. | 0. | 0. | 472. | 18. | 0. | 0.1 |
| 127 | 4835. | 1444. | 1918. | 206. | 0. | 0. | 13. | 0. | 0. | 453. | 20. | 0. | 0.1 |
| 128 | 4204. | 1765. | 1726. | 265. | 0. | 0. | 8. | 0. | 0. | 392. | 24. | 0. | 0.1 |
| 129 | 3246. | 2110. | 1514. | 419. | 0. | 0. | 5. | 0. | 0. | 296. | 31. | 0. | 0.1 |
| 130 | 2347. | 2370. | 1225. | 578. | 0. | 0. | 4. | 0. | 0. | 200. | 40. | 0. | 0.1 |
| 131 | 2229. | 2481. | 1043. | 796. | 0. | 0. | 4. | 0. | 0. | 139. | 38. | 0. | 0.1 |
| 132 | 1784. | 2129. | 824. | 953. | 0. | 0. | 2. | 0. | 0. | 129. | 43. | 0. | 0.1 |
| 133 | 1424. | 1992. | 701. | 1168. | 0. | 0. | 2. | 0. | 0. | 93. | 47. | 0. | 0.1 |
| 134 | 1102. | 1767. | 770. | 1310. | 0. | 0. | 1. | 0. | 0. | 65. | 52. | 0. | 0.1 |
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| 163 | 6851. | 5851. | 7778. | 1426. | 58. | 12. | 0. | 10. | 56. | 386. | 64. | 56. | 0.0 |
| 164 | 5233. | 3641. | 9256. | 1575. | 68. | 9. | 0. | 8. | 62. | 239. | 69. | 62. | 0.0 |
| 165 | 3399. | 2293. | 9724. | 1889. | 110. | 7. | 0. | 7. | 68. | 170. | 74. | 68. | 0.0 |
| 166 | 2281. | 1663. | 9225. | 2444. | 88. | 6. | 0. | 6. | 78. | 83. | 77. | 78. | 0.0 |
| 167 | 1506. | 1030. | 7770. | 3307. | 58. | 5. | 0. | 5. | 91. | 59. | 76. | 91. | 0.0 |
| 168 | 1063. | 714. | 3175. | 4746. | 40. | 6. | 0. | 6. | 145. | 43. | 72. | 145. | 0.0 |
| 169 | 970. | 381. | 1886. | 9050. | 31. | 4. | 0. | 4. | 153. | 38. | 72. | 153. | 0.0 |
| 170 | 692. | 271. | 1230. | 10068. | 22. | 2. | 0. | 2. | 138. | 30. | 71. | 138. | 0.0 |
| 171 | 449. | 207. | 809. | 10421. | 26. | 2. | 0. | 1. | 126. | 20. | 77. | 126. | 0.0 |
| 172 | 246. | 189. | 556. | 10444. | 44. | 1. | 0. | 1. | 113. | 10. | 77. | 113. | 0.0 |
| 173 | 109. | 146. | 567. | 10222. | 57. | 1. | 0. | 1. | 93. | 6. | 66. | 93. | 0.0 |
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| 176 | 29. | 47. | 87. | 9245. | 140. | 2. | 0. | 2. | 149. | 1. | 64. | 149. | 0.0 |
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| 187 | 0. | 0. | 0. | 361. | 122. | 24. | 0. | 24. | 2034. | 0. | 0. | 2034. | 0.0 |
| 188 | 0. | 0. | 0. | 350. | 96. | 14. | 0. | 13. | 1654. | 0. | 0. | 1654. | 0.0 |
| 189 | 0. | 0. | 0. | 113. | 32. | 4. | 0. | 4. | 1113. | 0. | 0. | 1113. | 0.0 |
| 190 | 0. | 0. | 0. | 55. | 84. | 5. | 0. | 5. | 832. | 0. | 0. | 832. | 0.0 |
| 191 | 0. | 0. | 0. | 19. | 45. | 4. | 0. | 4. | 630. | 0. | 0. | 630. | 0.0 |
| 192 | 0. | 0. | 0. | 0. | 27. | 1. | 0. | 1. | 429. | 0. | 0. | 429. | 0.0 |
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| 197 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 95. | 0. | 0. | 95. | 0.0 |
| 198 | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 56. | 0. | 0. | 56. | 0.0 |
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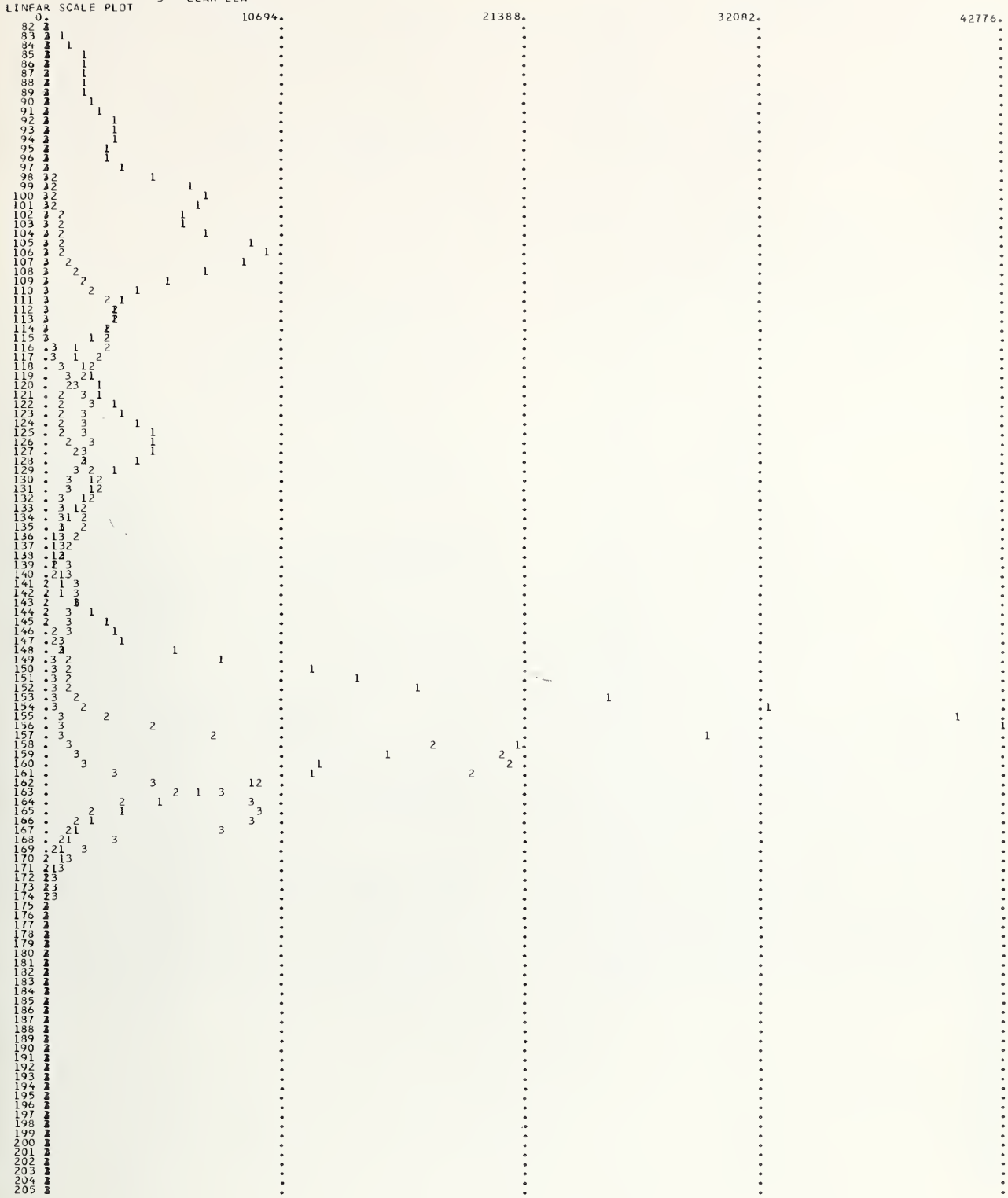
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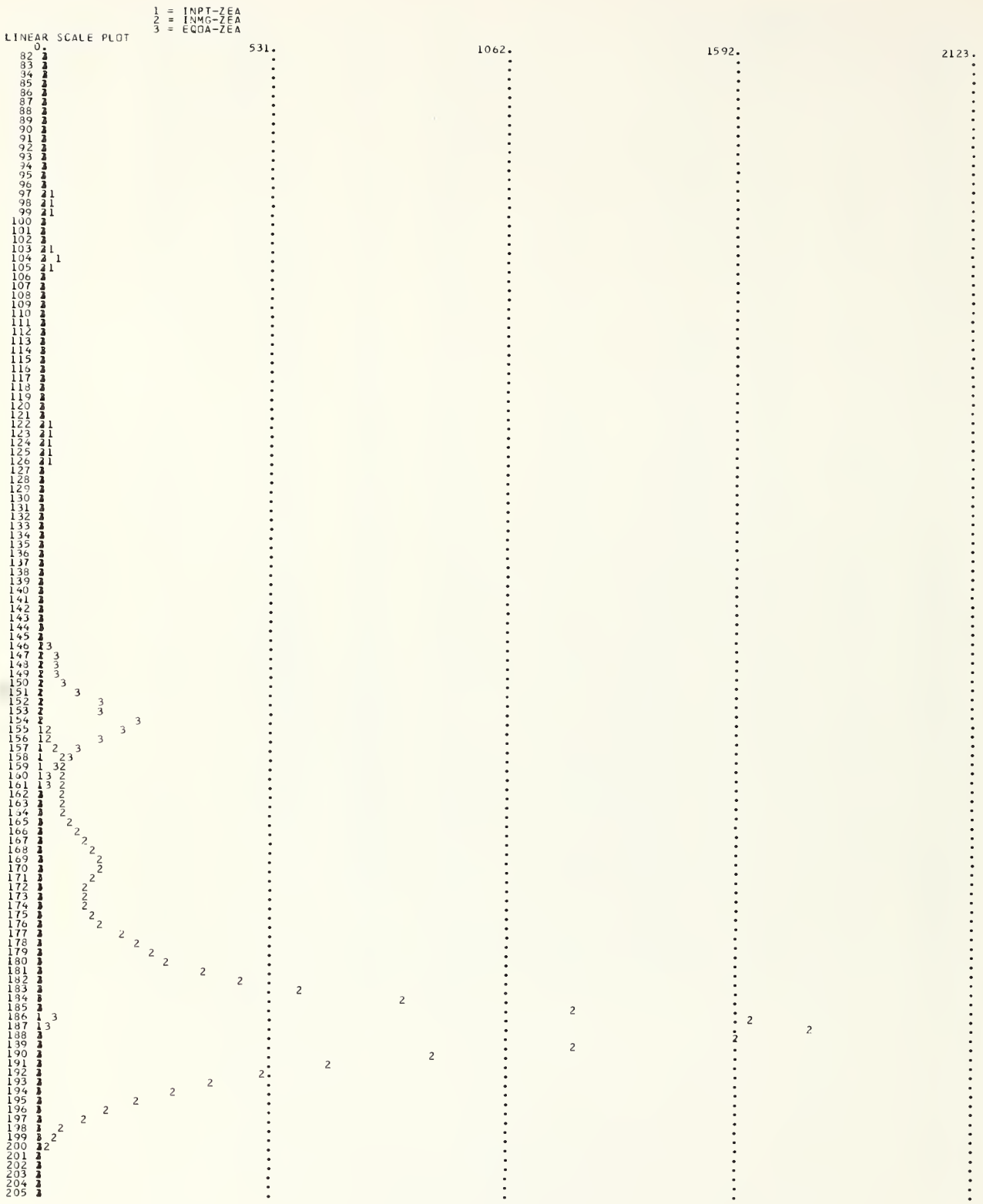




* 1976-G.P.O./1702-S/671-583/71

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